the OIL AND GAS JOURNAL
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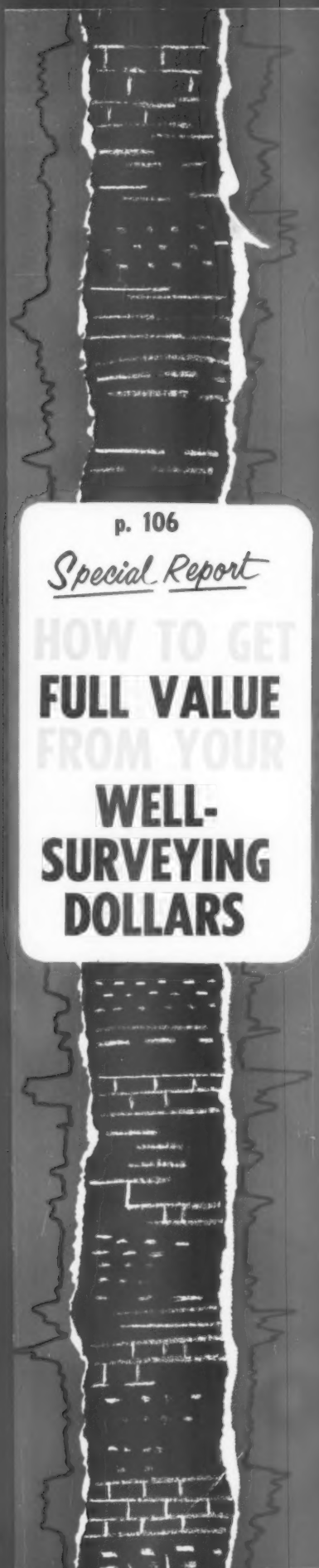

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Special Report

HOW TO GET
FULL VALUE
FROM YOUR
WELL-SURVEYING DOLLARS

Major gas legislation appears certain ▸ 79

Socal-Kyso merger will bring market changes ▸ 81

Compact layout—fast turnaround ▸ 143

New approach to pipeline crossings ▸ 151

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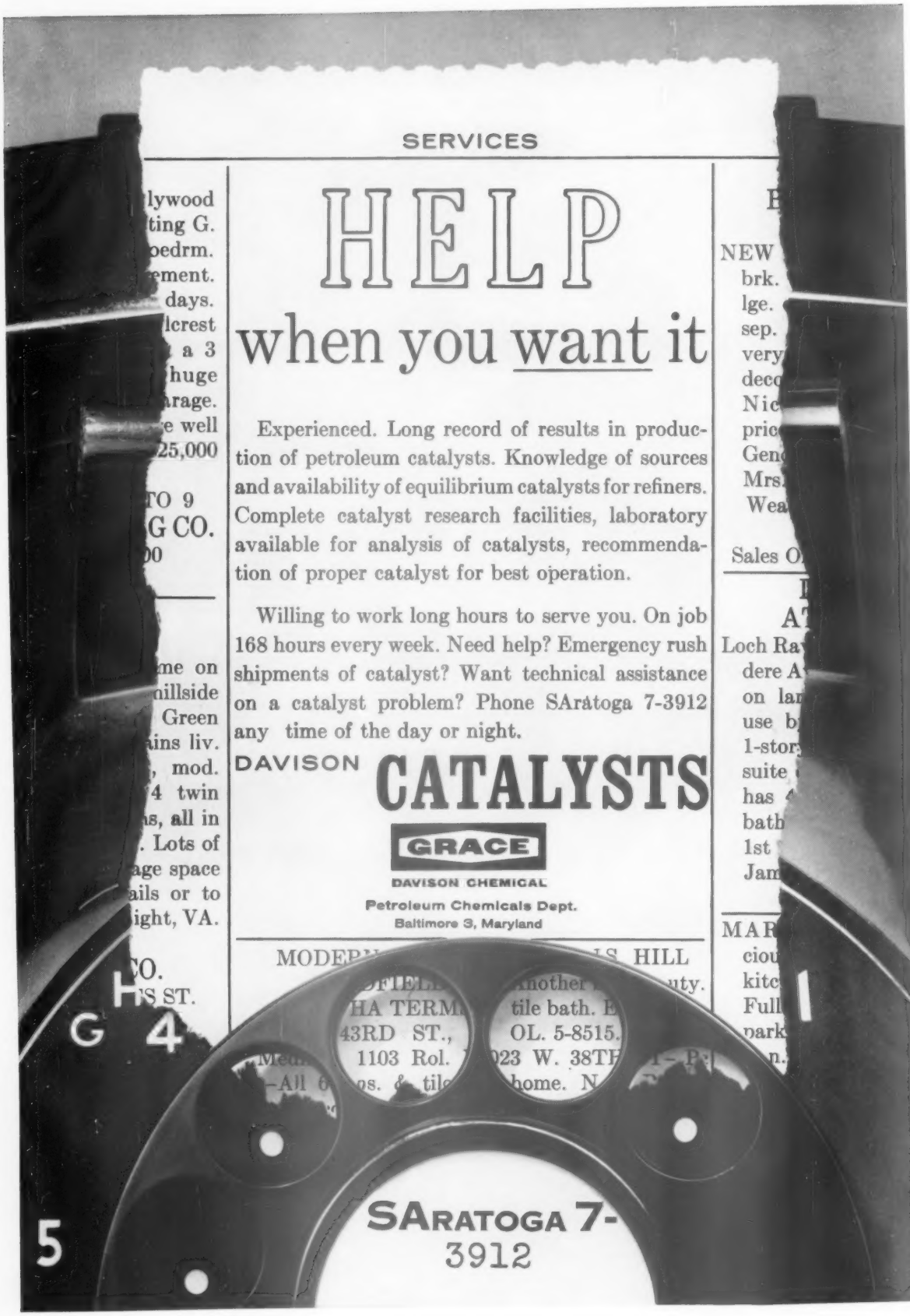
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The OIL AND GAS JOURNAL
Vol. 59, No. 24

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SPECIAL REPORT ON WELL LOGGING

SPECIAL REPORT ON WELL LOGGING 106-124

Use the Right Log 106

By W. B. Bleakley

Good well logs are cheap. But the wrong log for existing well conditions is a waste of money. Each type of log is designed for use under certain conditions, and when these conditions exist, that type of log should be used.

True Resistivities from Conventional Electric Logs 113

By Hubert Guyod and John A. Pranglin

Here's a new method that will salvage many conventional electric logs, and make correct interpretation possible. Procedure described here should make the discovery of previously unrecognized reservoirs possible.

Logging Empty Holes 119

By C. G. Rodermund, R. P. Alger and J. Tittman

When the borehole contains only a gas, specialized logging methods are needed to get quantitative information on porosity and saturation. The density logging tool makes it possible to prepare logging programs to suit all conditions involving wells drilled with air or gas.

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By Jack Marsee and R. J. Duran

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Operating costs—furfural or phenol extraction.

New Alky Unit Has Compact Layout, Low Maintenance, Fast Turnaround 143

By Stanley Weil and G. W. G. McDonald

Midland Coop's 1,300-bbl. unit includes these features: (1) All sections designed for acidic conditions, (2) reduced turnaround time, due to specific design criteria, and (3) reactor is conventional, but particular attention was paid to the features influencing reaction conditions.

Sampling System Vital in Chromatographic Control 147

By F. H. Harvey and W. J. Baker

Best instrument performance possible accrues when the equipment analyzes accurately the sample it receives. Delivery of a representative sample is most important.

Processing Notes 149

Hydrocarbon-acetylene capacity to almost double—do-it-yourself, or contract plant security—Cato now operating in new plant.

New Approach to Pipeline Crossing 151

By Walter E. Riley

An economical solution to the pipeline-crossing problem may be achieved by providing a twin-arch pipeline span, in which two inclined arched structures are located side by side and connected together by cross-struts to provide lateral stability.

Low-Water-Loss Cements Improve Formation Cement Squeezes 154

By H. J. Beach, T. B. O'Brien, and W. C. Goins, Jr.

Part 2 of 2 parts. Gulf Oil's success in cement squeeze jobs in one typical area was increased from 60 to 85% with the use of low-water loss cement. And big savings have been made by conducting the jobs so that cement need not be drilled out later.

THE OIL AND GAS JOURNAL **Newsletter**

June 12, 1961

Climate in Washington is changing on gas legislation.

It's important that you **understand what's taking place** because major changes in natural-gas regulations now appear inevitable.

More people are convinced that present regulatory approach will not work. Many other groups besides gas-producers are now asking for a change.

Back of this trend: Realization is growing for the first time that no one is benefiting from the present near breakdown of regulation, that eventually shorter supplies and higher prices will result.

That's real explanation for the flurry of proposals from the administration, state regulatory agencies, and the gas industry. Pressure now is on Congress to pick a way out—for the alternatives, see p. 79.

▼ ▼ ▼

Two developments at the Interstate Oil Compact Meeting in Houston:

. . . Two **new gas regulations proposed** by FPC came under fire of member states. Rules would outlaw certain contract-quantity and take-or-pay clauses in gas contracts and would set standards of pipeline quality of gas. Both were attacked as unfair, wasteful, and an intrusion into states' rights (p. 84).

. . . The issue whether **some states are getting more** than their share of the crude market by not prorating to market demand will get further attention from a special committee (p. 84).

▼ ▼ ▼

Those **South Bend oil-marketing convictions** are headed to the Supreme Court.

Ditto Sinclair's unusual antitrust conviction on coercive TBA tie-in sales.

Eleven oil firms were fined from $5,000 to $50,000 each at South Bend on federal antitrust charges they conspired to fix prices ending a gasoline price war. Several have served notice they will fight the issue out in higher courts.

Sinclair already has lodged its appeal from a circuit court conviction. Sinclair had no written agreement calling for dealers to sell a particular line of TBA but the court inferred a tacit understanding existed between Sinclair and its dealers (p. 96).

▼ ▼ ▼

Two important price changes in tubular goods have been made by U. S. Steel.

Price of X-52 seamless black line pipe h as been cut by $18 per ton, roughly 10%. Af-

fected sizes are 6⅝-in. through 12¾-in. only. U. S. Steel National Tube Division also granted its distributors an additional 4% commission on casing, tubing, drill pipe.

Cut in line pipe is of limited importance. Question is whether it will spread to other types and sizes. The extra commission will allow National Tube distributors to reduce their prices by this amount to meet competition (p. 90).

A lot of drilling people on the Gulf Coast are **excited about new oil muds** now being introduced.

For the first time, the oil muds are quite stable and relatively low in cost. They keep shale sections from sloughing. They prevent differential-pressure sticking of drill collars. They contain water enough to make them relatively fireproof.

Problems remaining: They're dirty to work with and it's a problem to dispose of them on the location.

Rig activity is picking up strong. Number working last week increased 64 to hit total of 1,823 for the country as a whole.

This is highest activity of the year. There have been only 2 weeks with a rig count above 1,800 so far this year. Weekly average for the year so far is 1,631.

Last year at this time, there had been 8 weeks with totals above 1,800 and the weekly average was 1,735.

▼ ▼ ▼

Rare Pennsylvanian find in San Juan basin of northwestern New Mexico may spur interest in deeper pay zones of area.

Continental Oil completed Table Mesa 3-18 in 3-27n-17w as new pay discovery for field on extreme western edge of basin. Flow was 21,500 M.c.f. daily and 15.5 bbl. of condensate per million. Gas is 5.4% helium.

Main pay in field is Dakota Cretaceous. Northwestern New Mexico has only six other Pennsylvanian fields—none of any importance.

Three wildcats are slated for **Porcupine Dome,** one of the largest surface-expressed structures in northern Rockies. Previous drilling there has been unsuccessful.

John W. Batts, Billings, will drill the wildcats in Rosebud County, Montana. All three will go to the Heath, with Tyler sands the main objective.

New producing-depth record for Texas Gulf Coast has been set by well completion in deep Wilcox through perforations at 16,357-16,404 ft.

Pure Oil's Kolar 1 was completed in Lavaca County's Vienna field, a shallow Wilcox producer. This is thirtieth reservoir in busy belt of ultradeep fields (p. 179).

Open-flow potential at well was 4,700 M.c.f. daily.

Vienna discovery beats previous depth for Wilcox production by more than 3,000 ft.

▼ ▼ ▼

Computer techniques promise **breakthroughs in process control.**

Their use in design of process units will cut time needed to evaluate control alternates.

Added benefit: Built-in surges within unit will be eliminated, lowering capital costs.

Control of these simplified, faster-response units won't depend on steady-state equations. Dynamic-state equations will be used. This will permit adjustment of process conditions the moment any upset occurs.

Mid-America Pipe Line will become the **most automatic** long-distance products pipeline in the nation when its new controls are checked out.

A single dispatcher in the Tulsa home office will control every operation from the receiving of product at the mainline's origin in Hobbs, N. M., to distribution at seven terminals in Nebraska, Iowa, Minnesota, Missouri, and Wisconsin.

Some **good news from abroad:** A proposed excess profits tax on the Venezuelan oil industry apparently has been blocked.

If this proves true, the industry can thank Juan Pablo Perez Alfonzo, minister of mines, for the victory. He went before the Chamber of Deputies and in an extraordinary closed-door session debated the issue with the lawmakers.

His contention: The tax would kill incentive for further oil progress (p. 100).

Other developments over the world:

Japanese have started drilling operations in North Sumatra designed to give Nippon refiners at least 14,500 bbl. daily of Indonesian crude within 3 years (p. 102).

Two new refineries are boosting Japan's booming processing industry. A 40,000-bbl. plant has gone on stream at Mizushima in Okayama Prefecture. Second plant of 30,000-bbl. daily capacity will go on stream this month in same area (p. 104).

Italy also is expanding its processing with eight new projects, four of which call for new refiners (p. 104).

Libya has just ruled that all transport contracts in Tripolitania must be secured through a central government office.

Australian refiners have gained a toehold in one of world's biggest fuel-oil markets with shipment of first cargo of residuals to Japan.

▼ ▼ ▼

All the returns are in for **first-quarter earnings,** and the effect of firm refined product prices was never better illustrated.

Forty-two oil companies studied by the investment firm of Carl H. Pforzheimer & Co. reported net income of $909.2 million for the first quarter, a 13.8% increase over 1960.

All but eight of the 42 showed higher earnings for the quarter, and 14 of the increases were above the industry average.

The favorable earnings stemmed from record operating volumes, further reductions in operating costs, and a better price climate. With refiners' gross margin up 31.6%, it was natural that companies engaged heavily in refining should show the greatest jump in profits. The internationals also did better than average.

Market memo

June 12, 1961

Wide-area pricing plans of some majors are flunking their first tests.

Bitter price wars which have developed in several major cities have forced either temporary abandonment or revision of the plans.

Two features are proving troublesome: Feathering out of prices from a basic pricing point and abandonment of guaranteed margins to jobbers and dealers.

In a price-war situation, companies find that feathering has tended to spread price cutting to adjacent areas and that dealers need support to survive.

Esso reportedly altered its plan in the Carolinas, trying to keep the Charlotte war isolated. Phillips temporarily abandoned its plan in Oklahoma to give its dealers support and keep them competitive in a bitter statewide fight.

The Kentucky Standard-California Standard merger plans (p. 81) really have independent refiners and marketers on the Gulf Coast buzzing.

Prospect of supplying 40% of Kentucky Standard's product needs is exciting to the independents, even though the business may not develop for a year or so. Major refiners will be barred from supplying Kentucky. Even a single independent cannot grab off more than 15% of the business.

Esso had been supplying 80% of Kentucky's needs. Big questions now: Will Esso move into the Kentucky preserve with marketing? What will Esso do with the products that now will have no home?

Gasoline markets early in June give this general picture: Weak on the East Coast, static on the Gulf Coast, and firming in the Mid-Continent.

Dealer tankwagon prices were reduced 0.7 to 1.8 cents per gallon in various eastern areas. For the most part, the larger cuts were accompanied by withdrawal of a 1-cent voluntary dealer allowance.

In the Midwest, the recent 1-cent advance on gasoline reportedly is taking hold. Product along the Great Lakes Pipe Line is firm at the new low of 12.25 cents. The upper part of the region is encouraged by Chicago activity. Wholesale gasoline prices there have moved up one-half cent on regular, and independent retailers have pushed up prices by 5 cents to the normal 30.9 cents per gallon. Price wars still dull the outlook in the lower parts of the region, especially Oklahoma.

Both the Gulf Coast and Mississippi River markets reflect no buying interest but the line is being held against discounting so early in the season. West Coast cargo inquiries in the Gulf market for gasoline at three-quarters of a cent discount went uncovered.

Good Wells Make Good News

A Report on Special Oilwell Services and Products

June 12, 1961

While Dowell may be known best for its fracturing, acidizing and cementing services, other Dowell services and products are helping operators solve production problems every day. Here are four recent examples:

- White County, Illinois (Old Oil Well) Completion was into the O'Hara lime through perforations from 3136 to 3147 feet and 3156 to 3158 feet. Production was only 20 bopd. Operator wanted to plug off lower zone temporarily, as well as a suspected channel between zones, so upper zone could be acidized. Dowell covered lower zone with peagravel and sand; then used Fixafrac* temporary plugging service to plug the channel. 700 gallons plugging fluid was used. Then the well was acidized. After treatment, production stabilized at 67 bopd pumping.

- Beauregard Parish, South Louisiana (Old Oil Well) Perforations at 11,000 feet were blocked by scale. When partly cleaned with acid, well went on vacuum; acid, and salt water load in annulus, flooded into formation. To avoid this flooding while removing scale, Dowell used 2000 gallons acid with 30-gallon slugs of temporary plug between every 250 gallons. As acid opened perforations, plugging agent quickly closed them. After scale was removed, hole remained full while tubing was round-tripped.

- Alberta, Canada (New Oil Well) This slim-hole well was completed into the Cardium through perforations from 3065 to 3071 feet. Operator specified that Sandlock* sand control service follow fracturing. 100 pounds of plastic-coated ground walnut shells were injected in three barrels of 2½ per cent acid, followed by one additional barrel of acid squeezed into the formation. At last report, no sand returns were evident. Pumps on nearby wells have had to be pulled and production halted due to sand returns.

- Ochiltree County, Texas Panhandle (Old Oil Well) Operator had to knife paraffin deposits from this 8000-foot well every five to seven days. Then the well was cleaned and treated by Dowell with Depban* paraffin inhibitor. Since then, operator has used a chemical injection pump to inject one gallon of Depban into casing every three days. At last report, after eight months of injection with Depban, no further knifing had been required.

Ask for full information on these and other Dowell products and services. Dowell services and products are offered in North and South America, Europe and North Africa. Dowell, Tulsa 1, Oklahoma.

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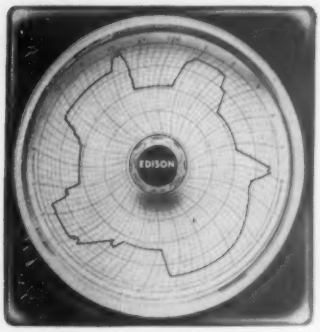

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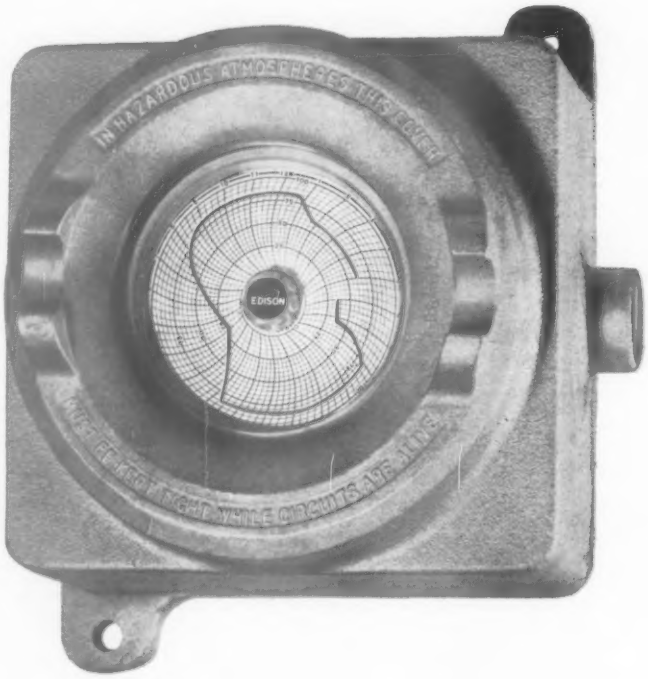

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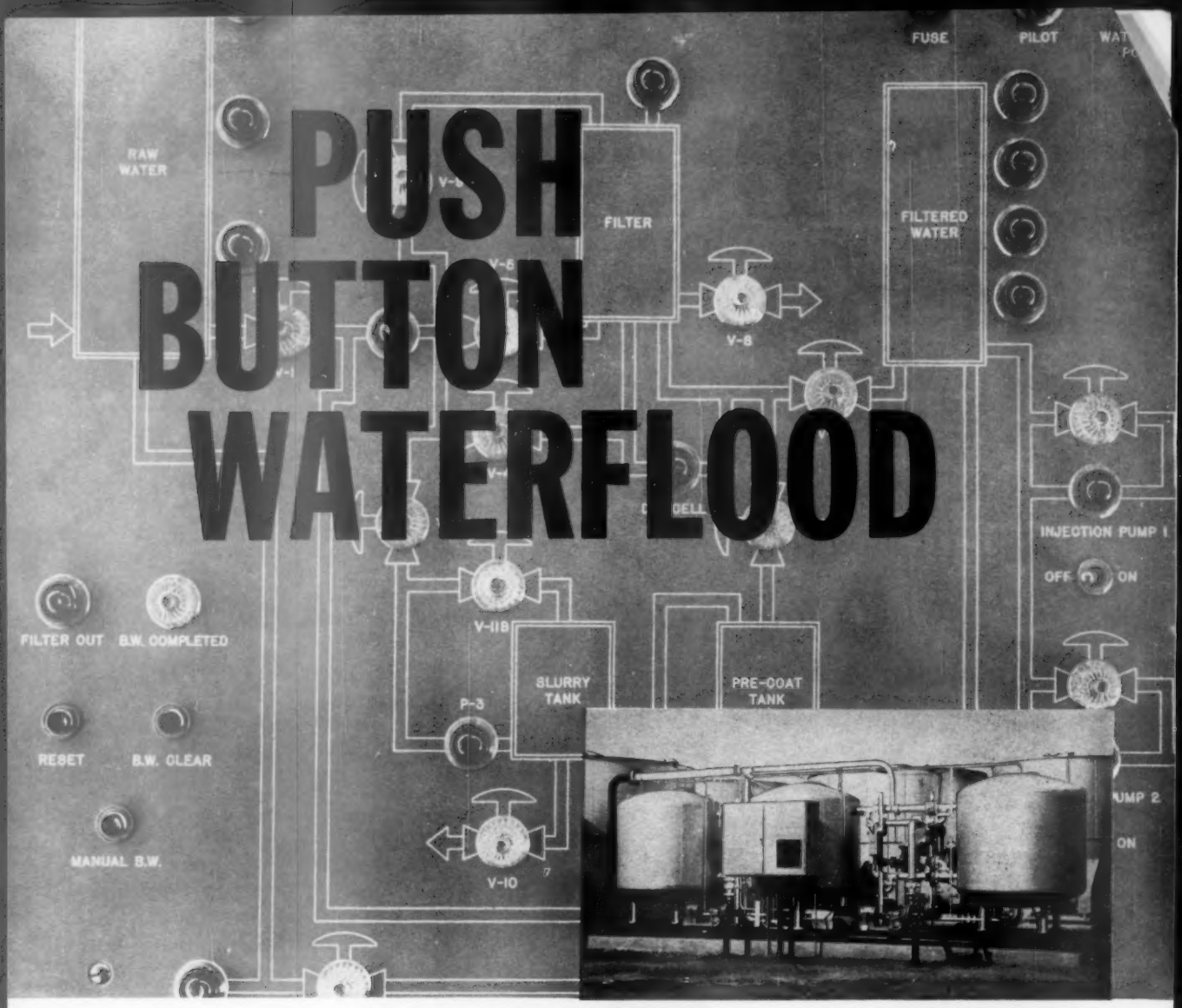

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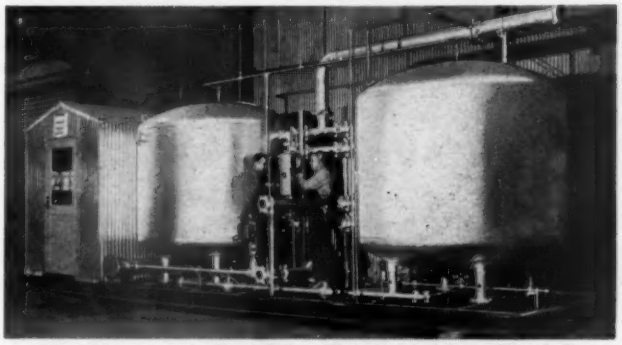

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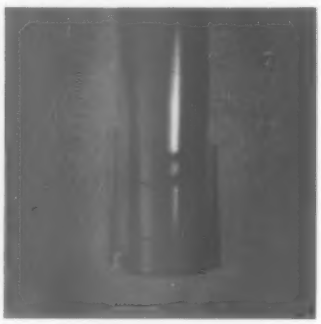

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AND JACKETED LOADING ARMS

Consider the advantages a Chiksan steam jacketed joint offers you. It is an effective long lasting product backed by over 10 years of proven-in-use service. It is available to you in a complete range of sizes from 2″ thru 12″ pipe size. It can be equipped with any one of a number of packing units tailoring the joint to your specific service. In addition to sulphur and asphalt, these joints and arms are equally adept at handling viscous oils, napthalene and heavy tars. There is another plus in the Chiksan steam jacketed joint—the many practical years of Chiksan know-how in designing installations. These recommendations teamed with Chiksan equipment are your assurance of a facility providing maximum flow-thru with greatest safety. For more specific details on steam jacketed joints and arms, write Chiksan.

CHIKSAN

fmc

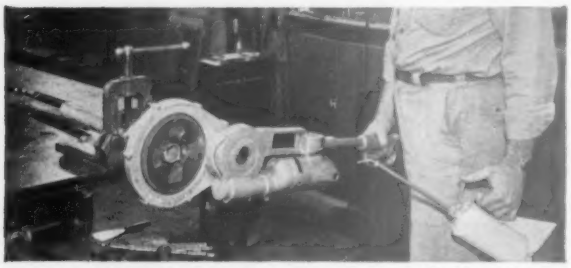
#61-63

CHIKSAN COMPANY—General Offices: Brea, California • Well Equipment Mfg. Corp. Division (Weco Unions, Hamer Valves) • Chiksan International • Chiksan of Canada Ltd.
Offices and Representatives in Principal Cities of the World

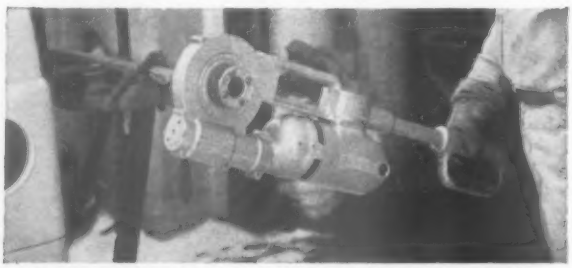
"Nothing Ever Saved More Time....."

than the new SIOUX Power Pipe Threader!

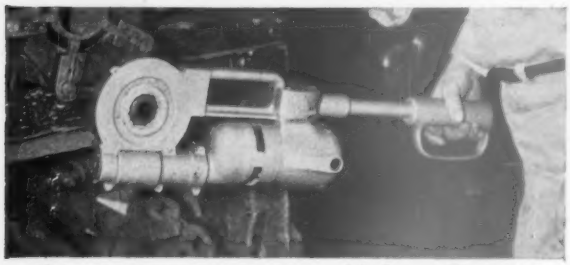
WITH THE SIOUX POWER PIPE THREADER you can thread ¼" to 1" pipe in 20 seconds; 1" and 2" pipe in one minute, 24 seconds! When labor costs 6½ cents per man per minute, a power tool like this for which there is a continuing need doesn't take long to pay for itself. The SIOUX Power Pipe Threader is said to be saving more time and money than any other major portable power tool!



SIOUX NO. 1508 PIPE THREADER in use with No. 1511 Speed Reducer.



THREAD PIPE ON THE JOB, in a hurry. Once the unit is in place it only takes one hand.



DRIVING GEARED DIE STOCK with SIOUX No. 1508 Pipe Threader and No. 38002 Adaptor.

WIRE IS PULLED THROUGH CONDUIT with SIOUX No. 1508 Pipe Threader and No. 1509 Portable Winch.

Your SIOUX Power Pipe Threader will also thread bolts; drill; auger; and open and shut valves. (It's a versatile, portable power package!)

Look for SIOUX in the yellow pages under "Tools, Electric" or write to

ALBERTSON & CO., INC.

SIOUX CITY, IOWA, U.S.A.

AIR IMPACT WRENCHES • AIR SCREWDRIVERS • ELECTRIC IMPACT WRENCHES • DRILLS • SCREWDRIVERS • GRINDERS • SANDERS • POLISHERS • FLEXIBLE SHAFTS • PORTABLE SAWS • VALVE GRINDING MACHINES • ABRASIVE DISCS

The "OILWELL" string...

PRODUCTS

SERVICES

STORES

99 years of know-how show in the "Oilwell" products and services that come to you through our field stores and pump shops, manufacturing plants, warehouses and offices serving the oil fields everywhere. When you buy from "Oilwell", you buy much more than a piece of equipment. You buy a *function* . . . a *means* of more profitable operation. Turn the page for examples of why the "Oilwell" string—*Products, Services and Stores*—means "plus value" in every piece of "Oilwell" equipment you buy.

USS

Oil Well Supply
Division of
United States Steel

Executive and Export Offices: Dallas, Texas

The "OILWELL" string . . . PRODUCTS SERVICES STORES

Every sucker rod a stretcher case?

We can't resist saying "stretcher case" because it refers to an "Oilwell" exclusive in sucker rod manufacture. Only "Oilwell" *stretch-straightens* rods (grades "Y," "T" and "O"), while at tempering heat. Why? To avoid introducing internal stresses that can be caused by cold straightening; and to cull out rods with surface defects (which show up most clearly when the rod is hot stretched).

Hot stretch-straightening is only one of the many reasons why "Oilwell" sucker rods are the most dependable you can buy. And you can choose from five different grades of "Oilwell" rods tailored for specific well conditions:

Grade "Y" for corrosive-inhibited deep wells. These boron-containing rods are "shot peened" as well as liquid quenched, over their entire length. They have both toughness and strength to give maximum service in corrosion-inhibited wells or wells having mild sulphuric brines.

Grade "T" for combatting embrittlement due to sour environment. Liquid-quenching and tempering of this low carbon, nickel content rod increases its fatigue resistance and improves service life in sour wells.

Grade "O" A new "Oilwell" Sucker Rod made of boron alloy steel. Liquid-quenching and tempering imparts exceptional resistance to fatigue under heavy loads. It also performs well under hydrogen embrittlement conditions where inhibitors are used to reduce pitting action.

Grade "L" for carbon dioxide corrosive conditions and medium-to-heavy non-corrosive wells. Made of fully normalized and tempered special nickel-chromium alloy steel, these rods have a "pearlite" grain structure having excellent resistance to carbon dioxide corrosion. Their long runs contribute to a big reduction in pulling costs.

Grade "N" for non-corrosive or inhibited wells. After bar stock has been roll-straightened and rod ends have been formed, these API-"C" rods are normalized to obtain optimum strength, toughness and resistance to shock and fatigue. Will give superior performance in non-corrosive or inhibited wells.

Any well can be pumped economically with one of the five "Oilwell" sucker rods described above. If you want more information, we suggest that you talk to the manager of the "Oilwell" store in your area.

USS and "Oilwell" are registered trademarks

Pump repair where you need it

When you're faced with the repair or reconditioning of any subsurface pump, just get it to the nearest "Oilwell" pump shop. These shops, located for the convenience of our customers, carry complete stocks of quality parts, are equipped with modern tools, and are staffed by experienced pump men. You will find "Oilwell" subsurface pump maintenance service completely satisfying . . . in the quality of the work we do . . . and in its surprisingly reasonable cost.

Where there's oil — there's "Oilwell"

Every dot on the map represents an "Oilwell" store. There's one near practically every important drilling, production, pipeline or processing operation. One is probably within an hour's drive of you now. And there's always stock not more than a night away! The managers and personnel of these conveniently located "Oilwell" supply stores give you not only fast service, but they can usually help with out-of-the-ordinary problems.

USS

Oil Well Supply Division of United States Steel

Executive and Export Offices: Dallas, Texas

CANADA'S

OIL & GAS

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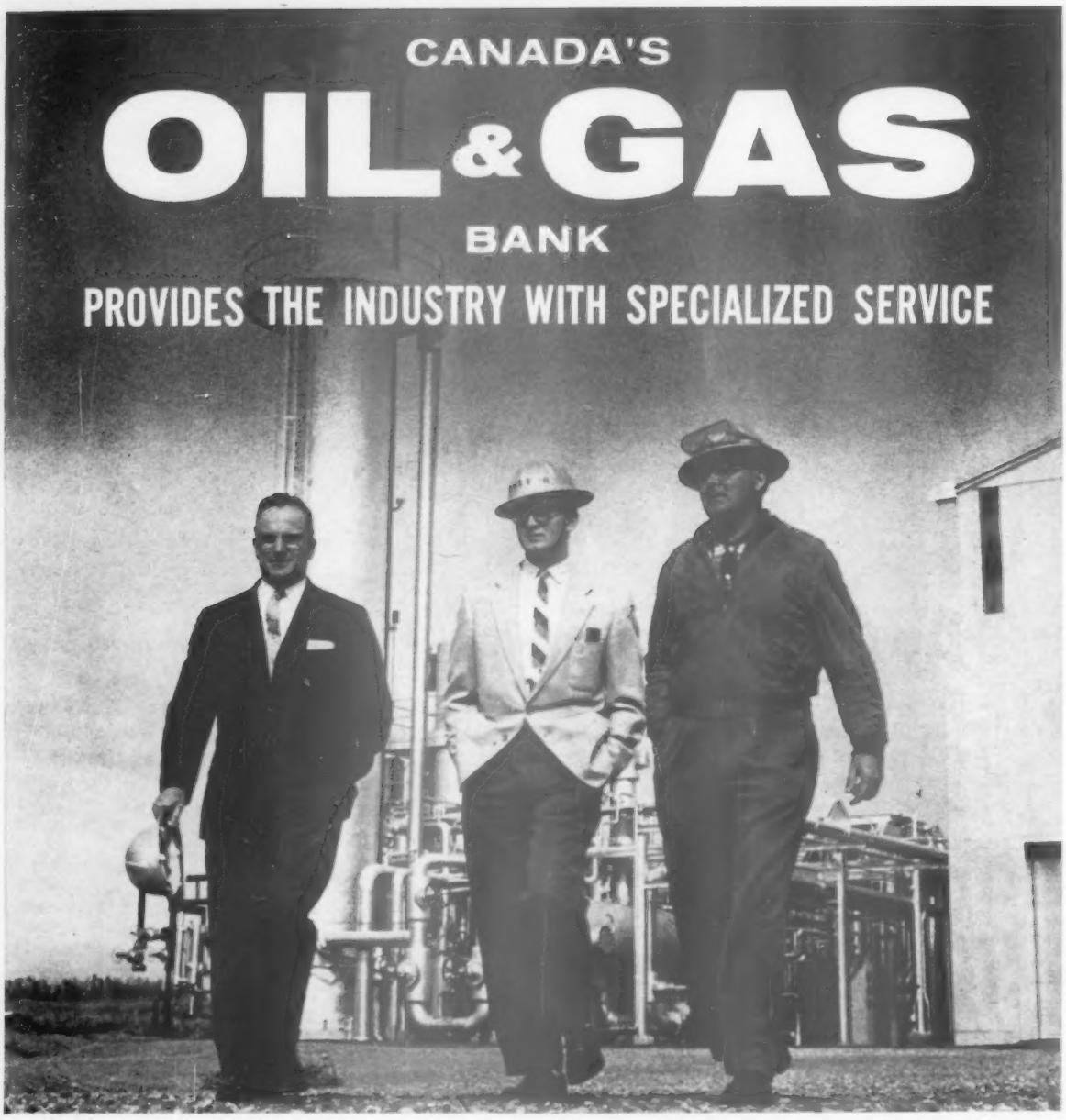
PROVIDES THE INDUSTRY WITH SPECIALIZED SERVICE



Banking men *and* oil men — the men who staff our Oil & Gas Department are by experience and training exceptionally well qualified to serve Canada's petroleum industry with every needed banking facility.

Among the most valuable services provided by this group of "banking-petroleum" experts are the periodic special bulletins covering industry activity. Up-to-date information on regulations, tariffs, financing, basic statistics and many another subject pertinent to the industry will be found in this series of bulletins. All are frequently revised to keep pace with developments.

For a list of the latest bulletins write to our Dallas representative: Mr. H. E. McClenaghan, Room 1523, 300 No. Ervay St., Dallas 1, Texas; or to The Royal Bank of Canada, Oil and Gas Department, 409 Eighth Avenue West, Calgary, Alberta.

We do not provide information on oil securities.

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Head Office: Montreal • New York Agency: 68 William St., New York 5, N.Y. • Dallas Representative: H. E. McClenaghan, Room 1523, 300 N. Ervay St.
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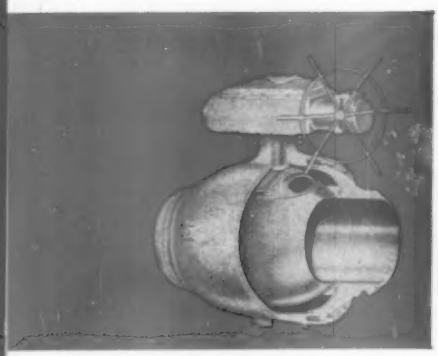

in for life: Once you weld a Rockwell Hypresphere valve into your pipeline, it's in for life —you'll never need to see the inside again. The seats in these spherical, full-opening valves are renewable forever, without taking the valve apart. And you know that today, tomorrow or any time in the lifetime of the line you need quick, sure shut-off, you'll get it with Hypraspheres. We'll be happy to send you complete information.

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ENGINEERING DEVELOPMENTS IN BULK CEMENTING

GIVE YOU **ECONOMY** THROUGH **EFFICIENCY**

HALLIBURTON ENGINEERING developed bulk cementing equipment providing two major savings to the producer.

First, this equipment has vastly increased the efficiency of handling the large volumes of cement required in today's drilling. Second — and equally important — bulk cementing equipment makes it possible to effectively control the blending of cements and additives in advance of the job custom-matching the slurry to exact well requirements. This control has led the way to Halliburton's development of special cements and additives — each designed to do a specific job better than ever before.

Take advantage of Halliburton's engineering teamwork in equipment design, material development, and job performance. It is backed by over three decades of experience in oilfields everywhere — and it is as near as your phone.

SPECIAL CEMENTS
custom blended to help solve these problems:

GILSONITE CEMENT — provides an efficient method of reducing slurry density without sacrificing compressive strength. The excellent bridging characteristics of the small Gilsonite particles also help prevent cement circulation loss in thief zones.

POZMIX CEMENT — Halliburton developed Pozmix Cements by blending natural or artificial pozzolans with portland cement to produce a light weight slurry with excellent gun perforating qualities. Pozmix is economical, yet it provides corrosion resistance, low permeability, and improved pumpability.

DIESEL OIL CEMENT (DOC) — The DOC slurry is designed to help shut off water in oil wells. Composed of portland cement, diesel oil or kerosene, and Halliburton's DOC-3 chemical dispersant, the slurry will not set until contacted by water. When squeezed into the water bearing zone, DOC absorbs water and forms a hard, dense set.

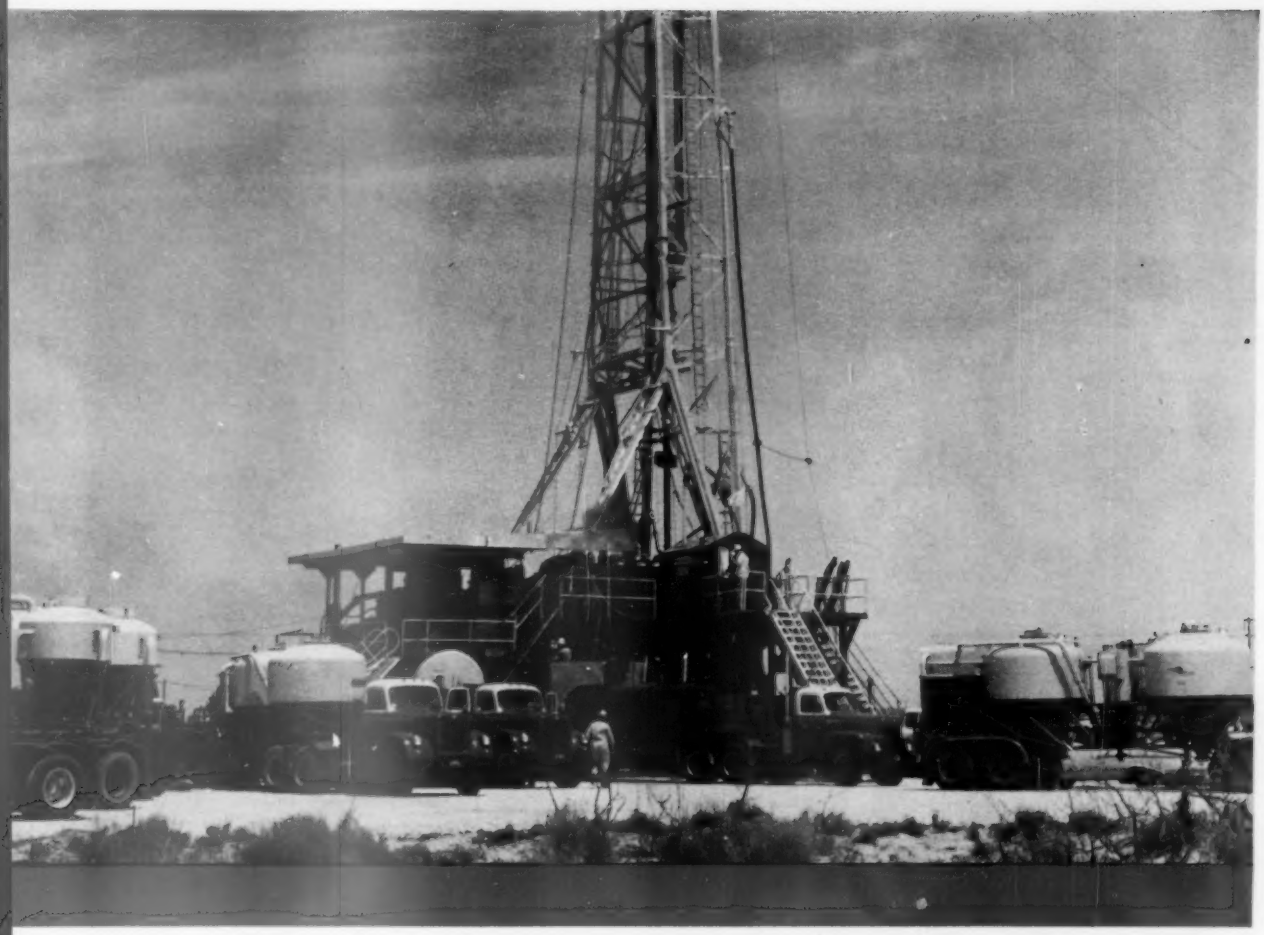
CEMENT ACCELERATOR
effectively reduces waiting-on-cement time

HA-5 ACCELERATOR — Early strength of Pozmix, portland or high-early strength cement can be improved by the use of small quantities of HA-5, one of many Halliburton accelerators.

CEMENT RETARDERS
for better cementing in hot wells

HR-7 RETARDER — This retarder has excellent dispersing qualities and is designed for use with high percentages of gel-cement.

HR-12 SUPER RETARDER — This retarder is for circulating temperatures even in excess of 400° F. and is compatible with all API Class D and E cements. The dispersing action of this retarder *reduces* the amount of water and Hi-Dense No. 2 needed for heavy weight slurries.



ADDITIVES

for further customizing cement slurries

SILICA FLOUR— For wells having temperatures in excess of 230°F., Silica Flour stabilizes a cementing composition against strength retrogression and maintains low permeability. Provides very high strength cement at elevated temperatures.

HALAD-9 LOW WATER LOSS ADDITIVE— This new Halliburton product helps reduce premature slurry dehydration, resulting in better primary and squeeze cementing operations.

DIACEL "D" LIGHT WEIGHT CEMENT ADDITIVE — Slurry yields can be increased to reduce densities to 11.0 pounds per gallon with this field-proven additive.

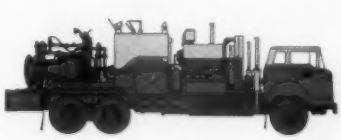
HI-DENSE NO.2 HEAVY WEIGHT ADDITIVE— This additive helps control high pressure oil and gas zones by increasing the slurry density of the cementing composition.

Your Halliburton man has the full list of special cements and additives which can be custom blended to do your specific job. See him for more details.

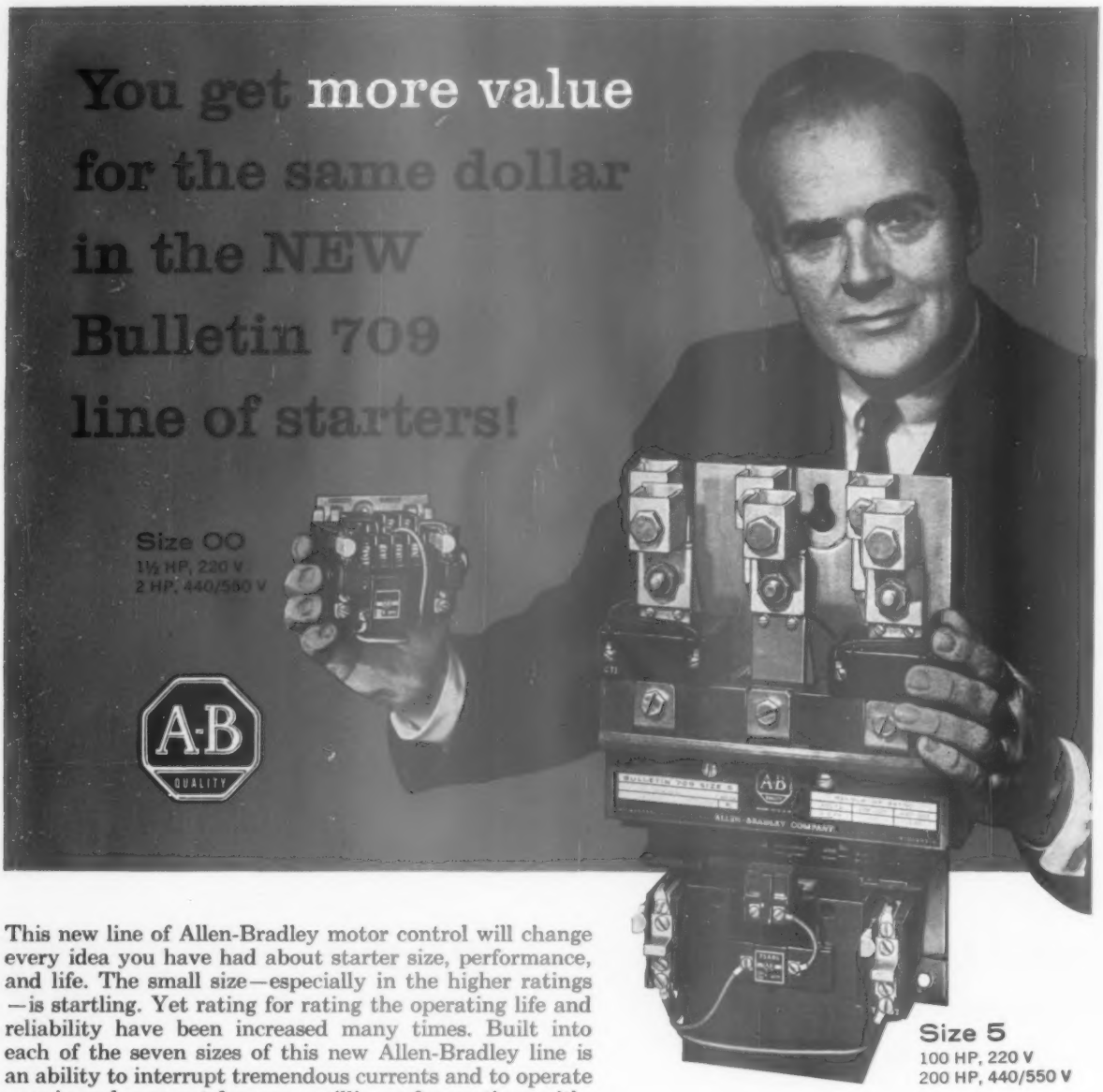
CEMENTING SERVICES

275 Service Centers . . . just minutes away from your well

Halliburton
COMPANY • DUNCAN, OKLAHOMA



You get more value for the same dollar in the NEW Bulletin 709 line of starters!



This new line of Allen-Bradley motor control will change every idea you have had about starter size, performance, and life. The small size—especially in the higher ratings—is startling. Yet rating for rating the operating life and reliability have been increased many times. Built into each of the seven sizes of this new Allen-Bradley line is an ability to interrupt tremendous currents and to operate year in and year out for many millions of operations without trouble or maintenance.

The new Bulletin 709 starters are just as advanced in appearance as they are in performance. All seven sizes have an aristocratic styling and a distinctive family likeness. Brooks Stevens, famous industrial designer, has given the enclosures such an attractive, modern style that these new starters will prove a distinct sales asset on any machine or installation.

Why not write today for more information on this revolutionary new line of Allen-Bradley Bulletin 709 *quality* across-the-line motor starters?

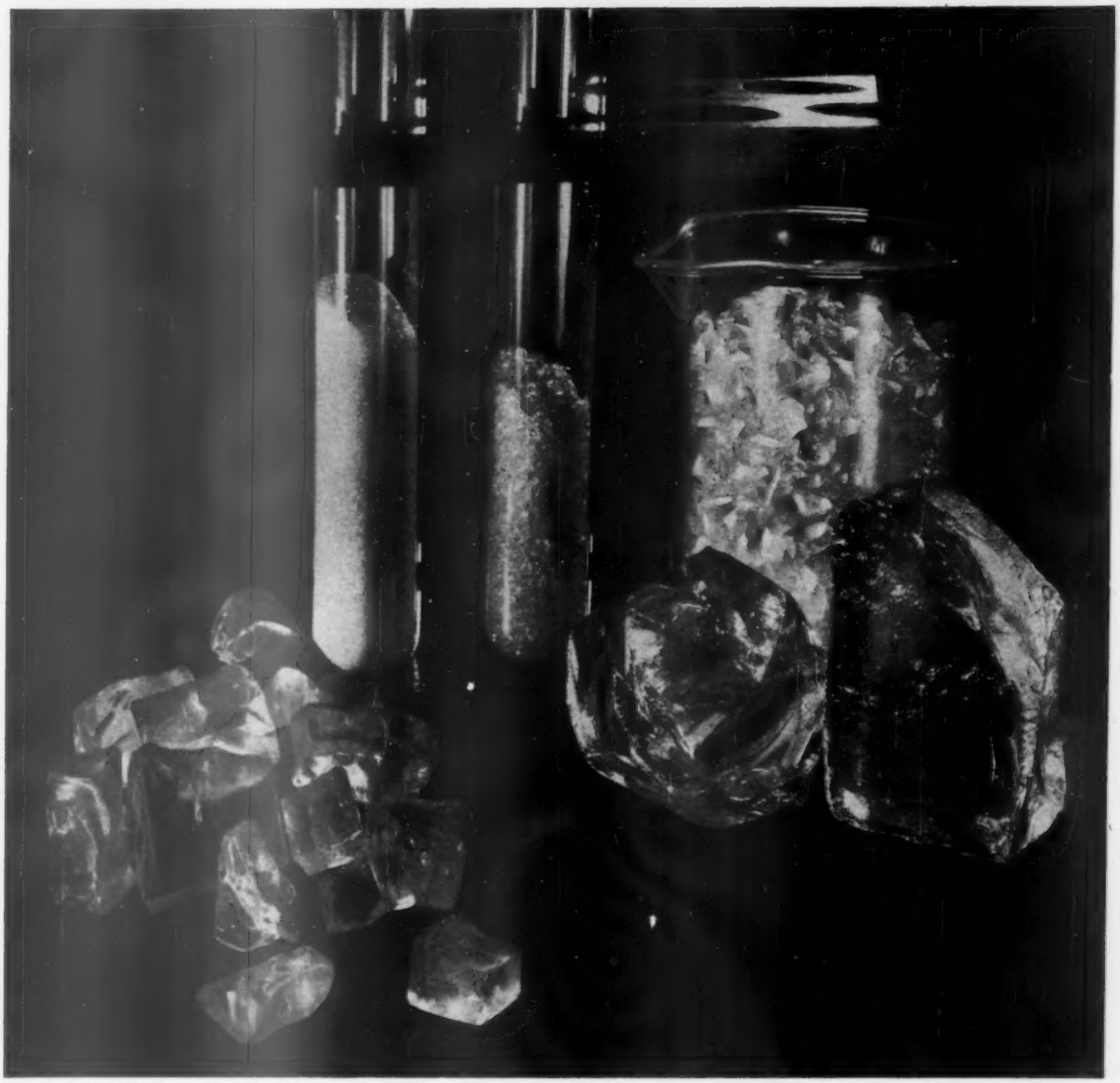
Note the compactness of both the smallest and largest starter in the new Bulletin 709 line. Ratings up to 100 hp, 220 v; 200 hp, 440-550 v.

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1304 S. Second St., Milwaukee 4, Wis.

QUALITY MOTOR CONTROL



Hagan Controlled Solubility Phosphates

accurately maintain phosphate residuals

Complex phosphates, particularly the sodium-calcium glasses, have long been known to provide excellent control of scale in waterflood injection systems and producing wells. However, maintaining the desired residual at all points was almost impossible until Hagan developed the Controlled Solubility formulations. Let's take a look at the factors involved.

Naturally, the first step is a complete analysis of the water to be used. Determining factors which influence the selection of a particular type of Controlled Solubility phosphate include total hardness, brine concentration and temperature.

It is now a simple matter to match a Hagan phosphate to the characteristics of the water. With five sizes and three chemical formulations in each size to choose from, a total range of fifteen different solution rates is available. One of these will match most waters precisely.

Available at leading oil field supply stores throughout the United States and Canada, Hagan Controlled Solubility Phosphates offer a real contribution towards maintaining maximum production efficiency. Write for a complete discussion of scale formation and its prevention. Address:

HAGAN
CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN DIVISIONS: CALGON COMPANY • HALL LABORATORIES • BRADFORD LABORATORIES • BRUNER CORP.

J.L

SUPPLY

Facts For Drillers

Determined To Cut Costs

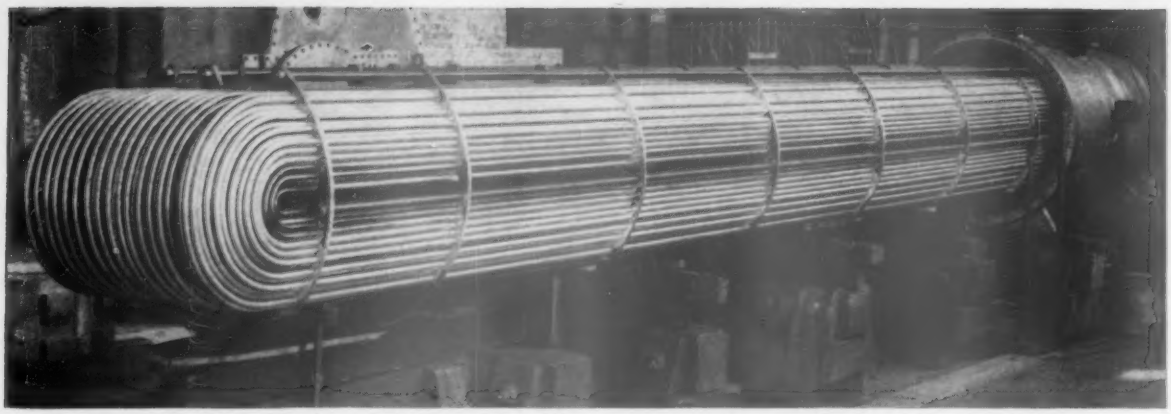
If you want reason-why facts about equipment that really does cut costs, let's get together!

J&L drill pipe and wire rope, McDowell "Fast-Line" couplings on light wall steel pipe, Gardner-Denver mud pumps—why be satisfied with hearsay about this and other equipment from J&L when you can have performance facts!

Call your J&L Supply man—or write us at Tulsa, Room 121, Drawer 2481.

Jones & Laughlin Supply Division—Tulsa

121



This typical bundle of long-length Anaconda U-Bend tube is the heart of the modern feedwater heater. To get optimum capacity and efficiency—and a more economical and compact unit—designers have lengthened heaters instead of increasing shell diameter.

IN POWER PLANT FEEDWATER HEATERS

Anaconda long-length U-bend tubes offer higher efficiency and greater economy

Feedwater heaters play an important role in the efficient operation of a steam power station—and with today's more demanding conditions, the trend is to the use of long-length U-bend tube bundles in these higher pressure, higher temperature heat exchangers.

U-bend tube design reduces the number of tube joints to one-half. Each U-bend tube takes care of its own expansion stresses. There's no floating head—one less gasketed joint—all resulting in a more economical, more compact heater.

Now Anaconda makes heat exchanger tubes to 100 feet. This means U-bend tubes with legs approaching 50 feet are available. And the radius of the bend can be as small as 1½ times the diameter of the tube—or as great as 30 inches. Dual-gage tubes are made with extra wall thickness in the area of the bends, to cut cost and weight.

With a large family of alloys available for heat exchanger tubes, Anaconda can meet almost every requirement. From Arsenical Admiralty-439 to the cupro nickel group, long-length U-bend tubes can be made to handle a wide range of temperatures and pressures.

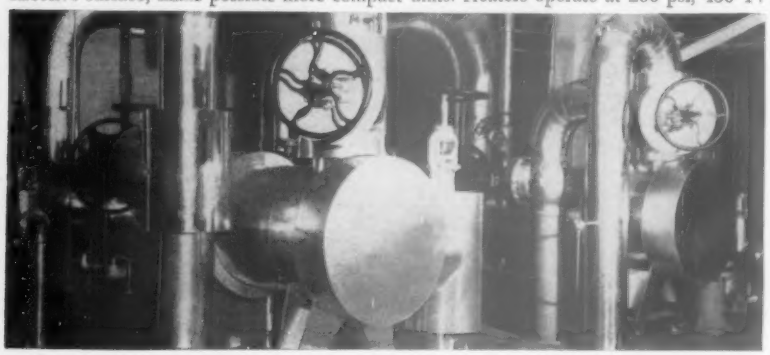
Specialists at Anaconda are constantly working with users and manufacturers of heat exchange equipment, helping to solve individual problems. This experience is available to you. For more detailed information on duplex tubes, dual-gage as well as U-bend tubes, see your Anaconda representative. Or write to: Anaconda American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 6061

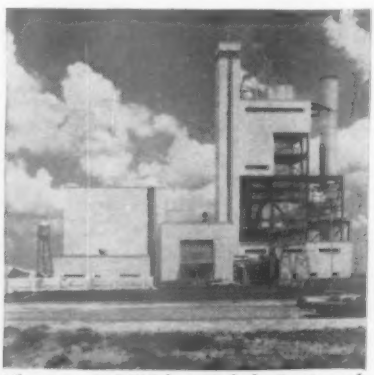
ANACONDA®

TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS

Anaconda American Brass Company

Two of the three feedwater heaters at Nichols Station, using a total of 1692 Anaconda U-bend tubes of Arsenical Admiralty-439. Griscom-Russell Co., Massilon, Ohio, designed and built the heaters. U-bend bundles of longer, smaller diameter tubes provide a more effective surface, make possible more compact units. Heaters operate at 200 psi, 450°F.





The new 112,500-kw Nichols Station of Southwestern Public Service Co., Amarillo, Texas.

How CB/S Compressor Designs Solve Your Problems in Gas Lift

CB/S
PACKAGED
COMPRESSORS

The C-B/Southern salesman is an experienced production engineer, whose know-how is incorporated in the design of gas lift compressor plants. His understanding of your lifting problems: gas injection depth, pressures needed and gas fluid ratios, help you select the exact gas lift compressor plant needed for maximum efficiency with either continuous or intermittent flow. This application experience coupled with engineering and manufacturing knowledge built more than 40,000 compressor plant horsepower last year. A phone call, a wire, or a letter is all it takes to put this experience to work for you.

To further help solve your gas lift problems C-B/S packaged compressor plants are available in horsepower ratings from 100 to 1440; unitized compressors, both reciprocating and centrifugal, to 10,500 horsepower.

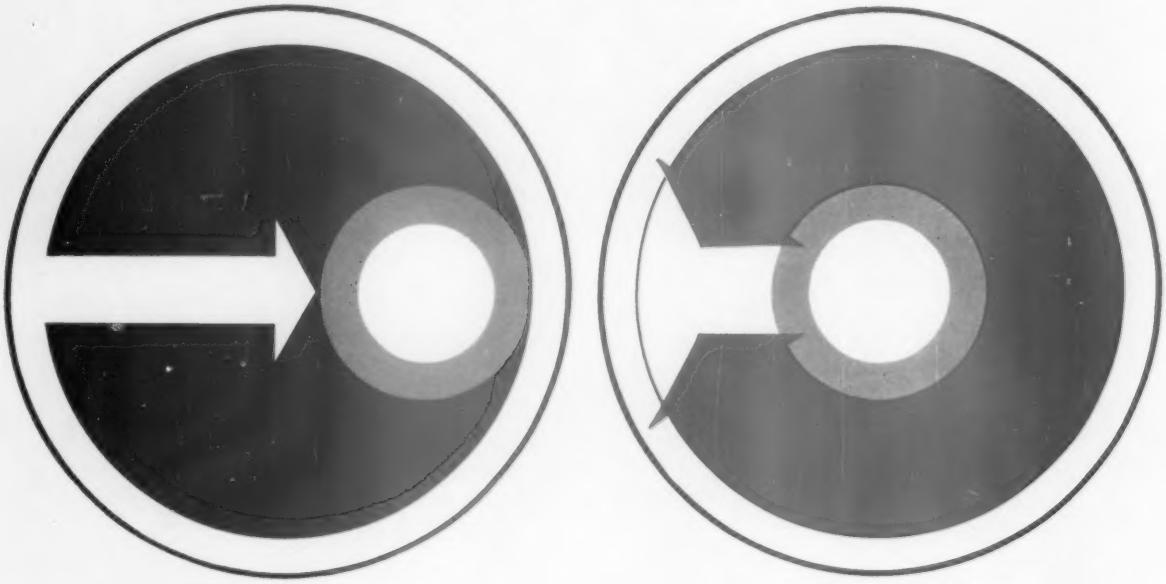
CB/S

C-B/Southern, P. O. Box 19267, Houston 24, Texas · HOmestead 8-5441

A division of The Cooper-Bessemer Corporation

MANUFACTURERS OF PACKAGED COMPRESSOR PLANTS FOR GAS GATHERING, GAS LIFT, GAS INJECTION APPLICATIONS

NEW PIPE-LAX IS THE WORLD'S BEST STUCK PIPE INSURANCE



When pipe is stuck . . .

Pipe-Lax gets it free.

IT SOAKS PIPE FREE

Now, from Magcobar research, comes the new way, the economical way of freeing stuck pipe. With new Pipe-Lax, an organic chemical concentrate, most losses of time, money, and patience because of stuck pipe and collars can be eliminated. In extensive field applications, Pipe-Lax has been used to free stuck pipe with better than 85 percent effectiveness! It is so inexpensive, it can be used whenever you have sticking problems.

For the best insurance available against the high cost of fishing for stuck pipe, keep a drum on your well. The sooner you use Pipe-Lax for freeing stuck pipe, the better your chances are of saving an expensive fishing job. Contact Magcobar today for complete details.

Magnet Cove Barium Corporation, Houston, Texas.

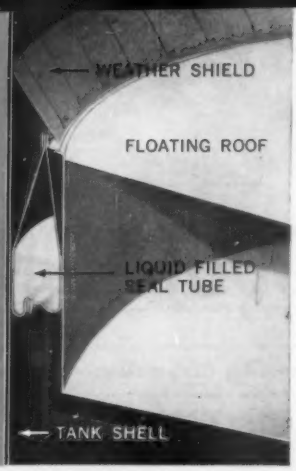
Magcobar
Complete
DRILLING MUD SERVICE

DRESSER INDUSTRIES, INC.
OIL • GAS
CHEMICAL
ELECTRONIC
INDUSTRIAL

Well Done with Magcobar Technology

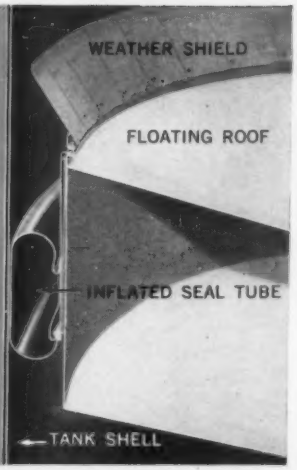
SR5 / HORTON
LIQUID FILLED FABRIC SEAL

- Sealing liquid holds envelope against tank shell.
- Pressure against shell is greatest at bottom, decreasing to zero at top of contact.
- Flexible ring support provides adequate clearance and better fit for all rim space variations.
- Sealing band and rim band vulcanized at bottom connection.



SR6 / HORTON
INFLATED FABRIC SEAL

- Gas holds envelope against tank shell.
- Constant mild pressure, maintained by simple gasholder, over entire surface.
- Positive means of supplying seal gas.
- Maximum clearance to accommodate rim space variations due to badly out-of-round shells.
- Vulcanized to form endless tube.
- Can be serviced from top of roof.

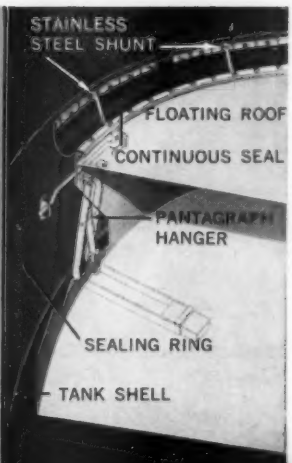


SR7 / HORTON
RESILIENT FOAM FABRIC SEAL

- Resilient foam holds envelope against tank shell.
- Mild and positive pressure against tank shell.
- Maximum clearance to accommodate rim space variations due to badly out-of-round shells.
- Endless sheet covers resilient foam, forming tight envelope.
- Can be serviced from top of roof.

SR3 / HORTON
METALLIC SEAL

- Continuous steel sealing ring.
- Pantagraph hangers hold sealing ring against tank shell with minimum pressure.
- Hangers keep roof centered in tank.
- Continuous seal closes rim space.



Widest Choice of Seals for Floating Roof Tanks

Because CB&I seals so successfully reduce evaporation, retard corrosion and minimize fire hazards, more CB&I floating roof seals are in use than all other designs. Four of the most popular CB&I seals are illustrated here. CB&I offers the widest selection. Talk over your requirements, for new or existing tanks, with CB&I. The most efficient design for your installation will be recommended.

CB&I's extensive experience (since 1922) with all types of sealing designs is at your disposal

CB&I

Chicago Bridge & Iron Company
332 South Michigan Ave., Chicago 4, Ill.
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CB-6116

SPECIAL REPORT TO MANAGEMENT

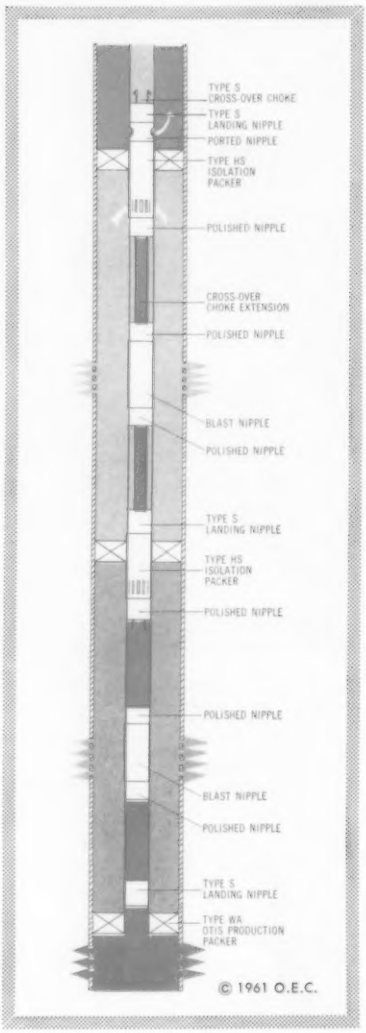
OTIS PRODUCTION NEWS

Volume II, Number 4 **Otis Engineering Corporation • Dallas** *Production Equipment and Services*

Otis Triple Zone Selective Cross-Over Completion Designed to Permit Production of Any Two Zones—Postpone Remedial Work

CORPUS CHRISTI—Operators in this area have found a new Otis Selective Cross-Over Completion ideal for producing new triple zone wells. The completion offers its greatest savings through selectivity of production, and is designed to postpone remedial operations which would entail moving a rig back over the hole. The completion is also designed to be made in standard 5½" casing using 2⅜" tubing to aid in holding downhole equipment costs to a minimum. This new Otis triple zone completion is designed to permit any one of the three zones to be produced individually with the other two blanked off, or two of the three zones to be produced simultaneously, directing the production from either zone through the annulus or the tubing as desired. When producing two of the zones simultaneously, one of the zones must be crossed-over just above the top packer through the use of a standard Otis Concentric Cross-Over Choke.

In addition to the above, this type of cross-over completion offers several other production advantages. The completion technique employed on initial installation is designed to permit each packer to be tested to the breakdown pressure of the zones before the next packer is set. Access to the upper zones is through the ports in the Sliding Side-Door® assembly of the Type HS Otis Retrievable Isolation Packer. Type HS Packers are used to isolate the upper two zones as shown in the accompanying installation diagram. In this installation, by straddling the upper zone with the top two packers, a short extension to the Otis Straight Flow or Cross-Over Choke acts to permit selective production of the middle and lower zones or the middle and upper zones through the tubing or annulus, with the alternate zone blanked off in each case. This also serves to permit chokes to be changed by standard wire line methods without requiring a rig over the hole.



In addition to these advantages, the completion technique is designed to permit any one of the zones to be exposed to the tubing or the casing, or both, with the other two zones blanked off for circulating, treating, and testing. Fracturing treatments on individual zones at pressures up to 4,500 p.s.i. have been performed in wells using this type of completion.

This is another Otis-engineered completion designed to provide the ultimate in economical, versatile, and efficient alternate-zone selective production. For more information on alternate-zone, selective and multiple completions, or for help with any other specific completion problem, call the Otis office nearest you or write Otis, Dept. 4-W, P.O. Box 35206, Dallas 35, Texas. You'll find your Otis Well Completion Specialists ready to help you . . . anxious to serve you.

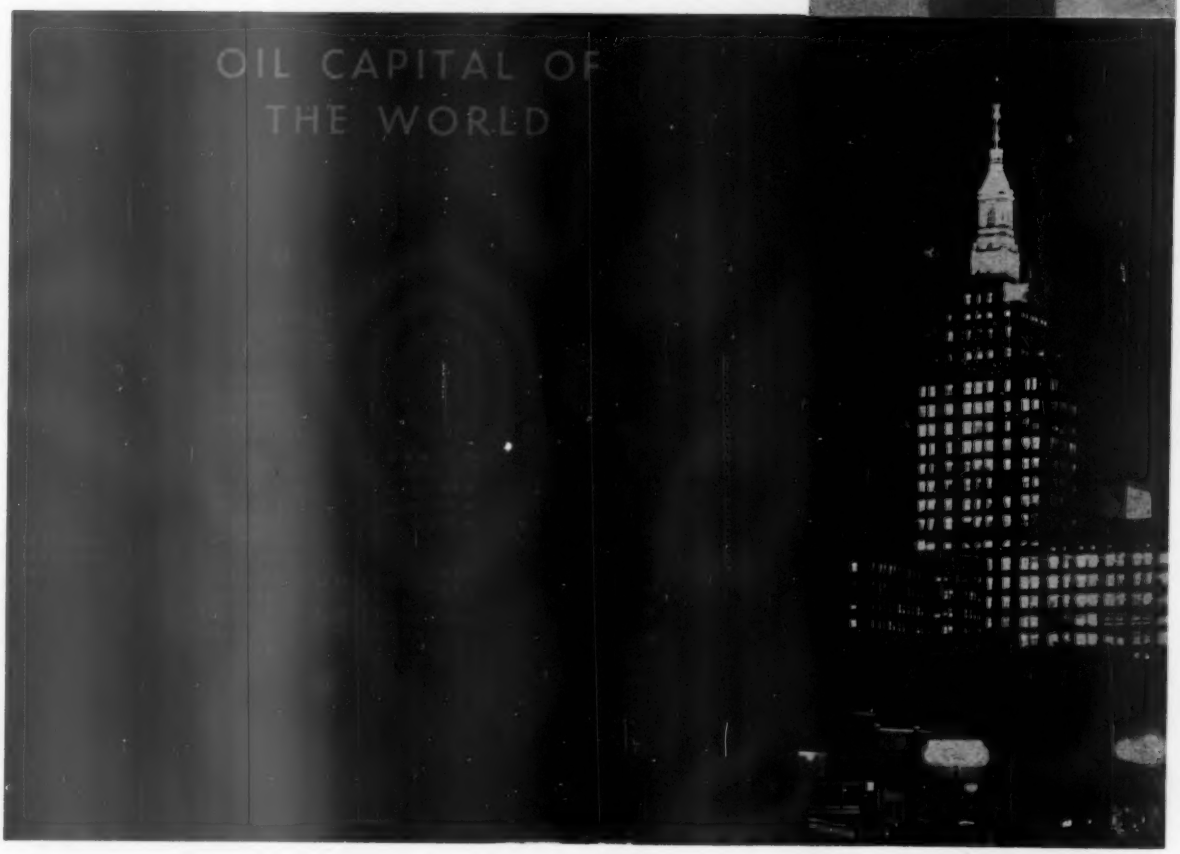
OTIS

Engineering Corporation

General Offices:

6612 Denton Drive • Dallas, Texas

TULSA NBT



National Bank of Tulsa is located in Tulsa, Oklahoma . . . the Oil Capital of the World. And in NBT's Oil Department banking men know oil as well as they know banking . . . because NBT continues to key its own progress to the healthy growth of the oil industry. Visit the Oil Department at National Bank of Tulsa . . . the Oil Bank of America.

OIL BANK OF AMERICA

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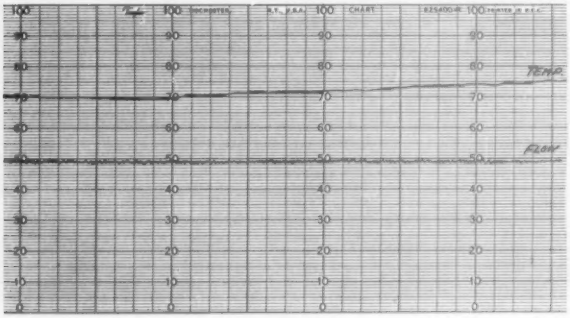
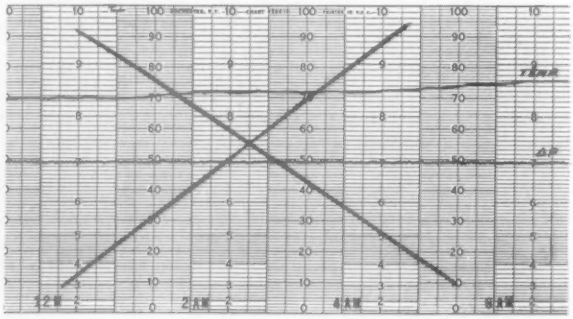
NEW

FROM

212T TRANSCOPE® Indicating
Flow and DP Transmitter

Now . . . calibration linear with flow obsoletes sectionalized charts





SPECIFICATIONS

Range Interval: *continuously adjustable 20" to 250" w.g.*

Accuracy of Calibration: (*Referred to input*)—*Transmitter* ½%.

Static Rating: *1500 psi.*

Overrange: *Can accept full static pressure overrange, reverse or direct.*

Case: *Sturdy, die-cast aluminum, for field mounting.*

Primary Materials: *Carbon steel or Type 316 S.S. Flanges and adaptors with Type 316 S.S. trim.*

Taylor Instruments

Taylor

The only DP transmitter that can be calibrated for output linear* with flow as well as differential pressure without changing parts

Really a "transmitter with a built-in computer", the No. 212T TRANSCOPE Force-Balance Flow and Differential Pressure Transmitter can be converted from linear with flow to linear with differential pressure (liquid level) simply by calibration. It employs a liquid-filled, diaphragm sealed primary unit and a unique secondary unit in which force balance is accomplished by a powerful motion servo and spring combination. Servo power makes possible these features, unavailable in conventional transmitters:

- Ratio and cascade control without intermediate, separate square root extraction.
- Simple analog computations involving flow and other variables pneumatically without an extra "black box".
- Elimination of the need for sectionalized charts.
- Indication at the process on a big 11¾" scale, visible up to 35 ft. away.

This ingeniously designed transmitter may be Calibrated Linear with Differential Pressure or Calibrated Linear with Flow, and can be either indicating or non-indicating. For computer control, for example, linearized flow is a logical short cut.

Use of a liquid-filled primary gives positive overrange protection. Working parts in the primary are exposed only to the filling liquid—not to the process. Static pressure compensation is inherent in the unique thrust pivot of the force beam. Connections are extremely convenient. Mounting facilities are more adaptable than ever before.

With all its outstanding features you pay no premium for the 212T Transmitter. Ask your Taylor Field Engineer for a demonstration, or write for **Bulletin 98413.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Ontario.

**Even without this unique feature, the 212T would still be a superior DP transmitter.*

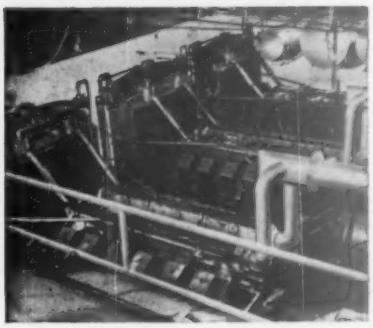
Convenient through-bolted flanges for easy servicing. Process connections top, bottom or side.

213T non-indicating model shows rear mounting and bottom process connections.

MEAN ACCURACY FIRST

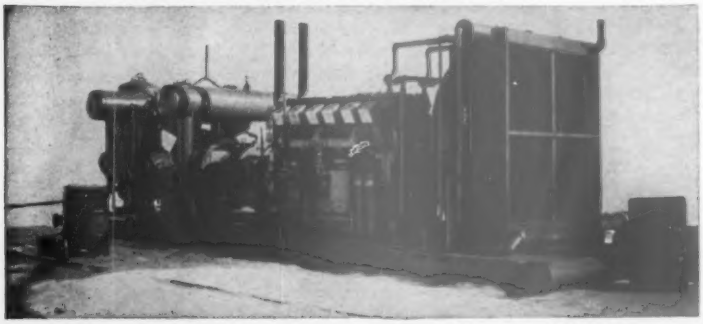
it's CLIMAX

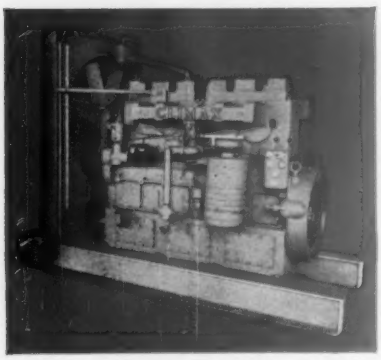
for DRILLING and PUMPING



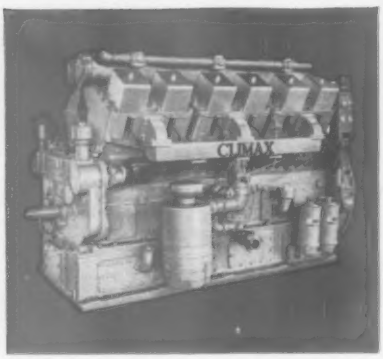
● Climax Engines have proven their reliability in hundreds of oil field installations. Single, well balanced design, rugged construction, and quality materials make them smooth running . . . for years!

for COMPRESSORS

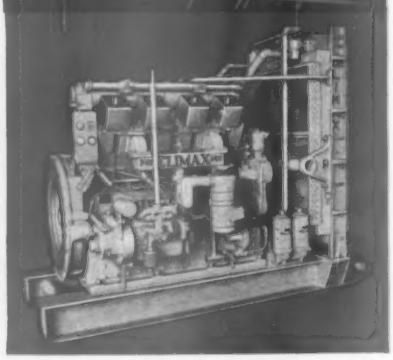




Model K-67—Max. hp 265 (Natural Gas)



Model V-125—Max. hp 605 (Natural Gas)



Model V-85—Max. hp 390 (Natural Gas)

CL-116

CONT. DUTY (NAT. GAS) →			DRILLING-PUMPING (80% RATINGS)						COMPRESSORS (65% RATINGS)				
Model	Bore & Stroke	Displ.	Peak Torque @ RPM	Brake hp at Speeds Indicated					Peak Torque @ RPM	Brake hp at Speeds Indicated			
				600	800	900	1000	1100		800	900	1000	1030
R-165	6⅛ x 7	1238	684 @ 750	81	105	117	127	135	557 @ 800	85	95	103	105
K-67	7 x 7	1616	955 @ 850	110	145	161	176	188	775 @ 800	118	131	143	146
K-75	7½ x 7	1855	1090 @ 800	126	166	185	204	218	885 @ 800	135	151	166	169
V-80	7 x 7	2155	1240 @ 850	140	188	210	230	246	1002 @ 800	153	171	187	190
V-85	7½ x 7	2474	1460 @ 800	164	223	246	266	284	1185 @ 800	181	200	216	221
V-122	7 x 7	3232	1920 @ 800	217	293	328	353	378	1562 @ 800	238	265	288	293
V-125	7½ x 7	3711	2240 @ 850	242	340	384	417	442	1820 @ 900	276	312	340	346

CLIMAX ENGINE MANUFACTURING CO. • DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY—CLINTON, IOWA

PRODUCT IMPROVEMENT WITH **PETRECO**

EFFICIENT DESALTING is the first step towards PROFITABLE REFINING

Salt removal is now a routine operation in all modern refineries. With the need for effective desalting widely recognized, the main problem today is the selection of that equipment which will do the most efficient job at the least possible cost.

When you need new or additional desalting facilities, keep these points in mind:

■ ***The first electric desalter was designed and installed by Petreco engineers.***

This was nearly a quarter of a century ago. The subsequent years of solid, practical experience in dealing with (and solving) desalting problems all over the world now enable Petreco desalting to yield salt removals in the 98-100% range. The fraction of a cent per barrel desalting cost is saved many times over by the gains in refining efficiency resulting from a clean charging crude.

■ ***The first chemical desalter was designed and developed by Tretolite engineers.***

Tretolite chemical formulations were the first ever to be used in desalting. Tretolite desalting units are the only exclusively chemical desalters ever to be sold and installed in the refining industry and are currently used to desalt a million and a half barrels per day. In fact, every important development in crude oil desalting has resulted from the Tretolite research, engineering and development program.

YOU GET

98-100% SALT REMOVAL

WITH PETRECO ELECTRIC OR

TRETOLITE CHEMICAL DESALTING

Because Petreco offers both kinds of desalters, the company has no "axe to grind". This means that you get an honest and objective appraisal of the method best suited to your operation.

There is no other desalting equipment on the market today that can offer you comparable efficiency of design. The operating records from installations around the world *prove* it! There's no other company, either, that can offer you Petreco's fund of desalting technology or Petreco's rich background in this highly specialized field.

PETROLITE CORPORATION

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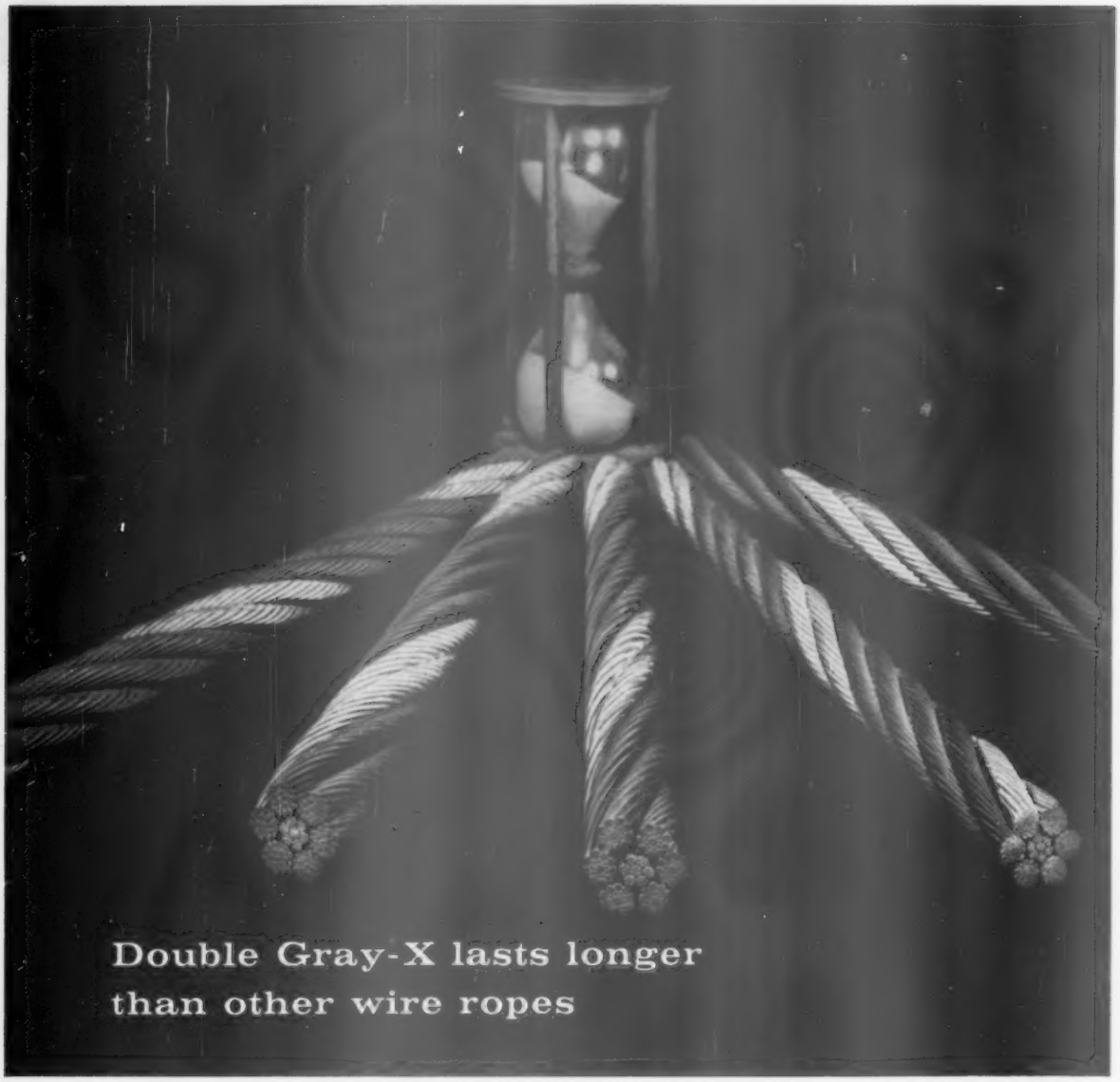
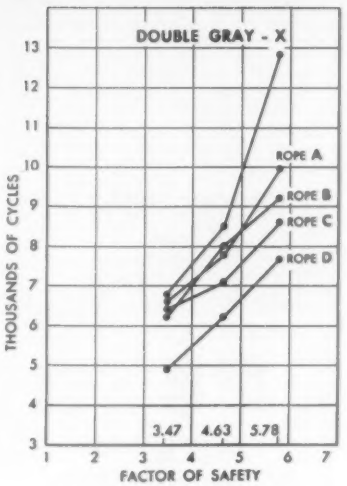


CF&I-Wickwire is making the wire rope of *tomorrow*...*today*. It's Double Gray-X —the rope with the molecular shield of molybdenum disulphide.

In an extended series of tests on a 25,000-lb. fatigue machine, CF&I-Wickwire's Double Gray-X outlasted four other major brands of high-strength rope at all three of the safety factors used. At the highest and most commonly-used safety factor, Double Gray-X had 45% more bending life than the average of other ropes tested. (Please see the chart at right.)

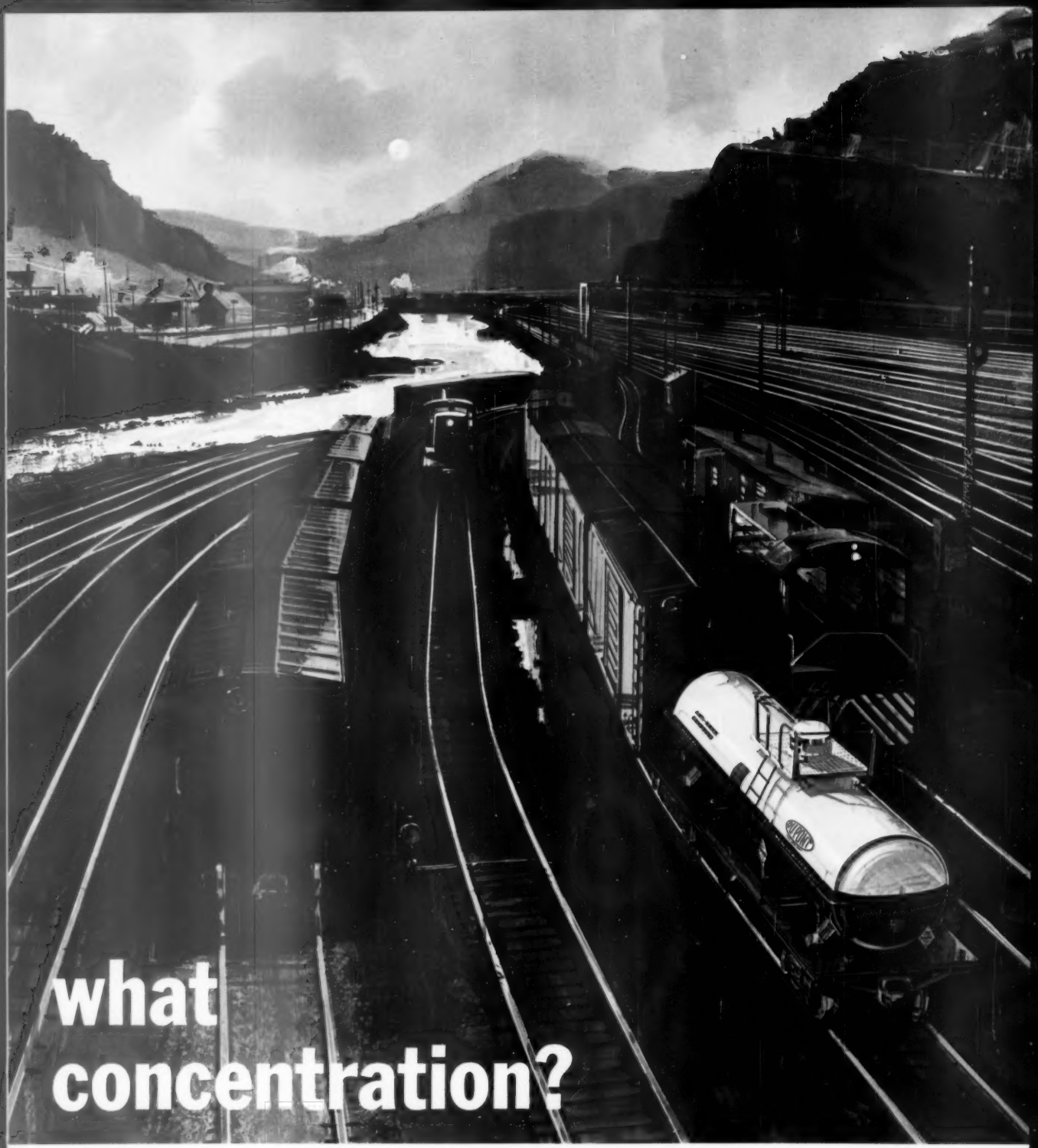
We'd like to give you some additional information on these tests . . . let you read some enthusiastic field reports from satisfied users . . . and show you how the molecular shield on Double Gray-X can help reduce your equipment-downtime costs. Contact your nearby CF&I sales office or distributor today. 8253



All test ropes were ½" 6 x 25 FW Preformed E.I.P.S. Lang Lay IWRC.

THE COLORADO FUEL AND IRON CORPORATION
Denver • Oakland • New York
Sales Offices in Key Cities

CF&I STEEL MADE IN U.S.A.



TETRAMIX* antiknock compound produces desired octane numbers in many fuels at lower cost than is possible with TEL or TML. It also offers refiners a new degree of flexibility in their choice and use of lead antiknocks . . . another example of the practical advantages of doing business with Du Pont.

E. I. du Pont de Nemours & Co. (Inc.), Petroleum Chemicals Division, Wilmington 98, Delaware.

*Trademark

LEAD ANTIKNOCK COMPOUNDS and other PETROLEUM ADDITIVES

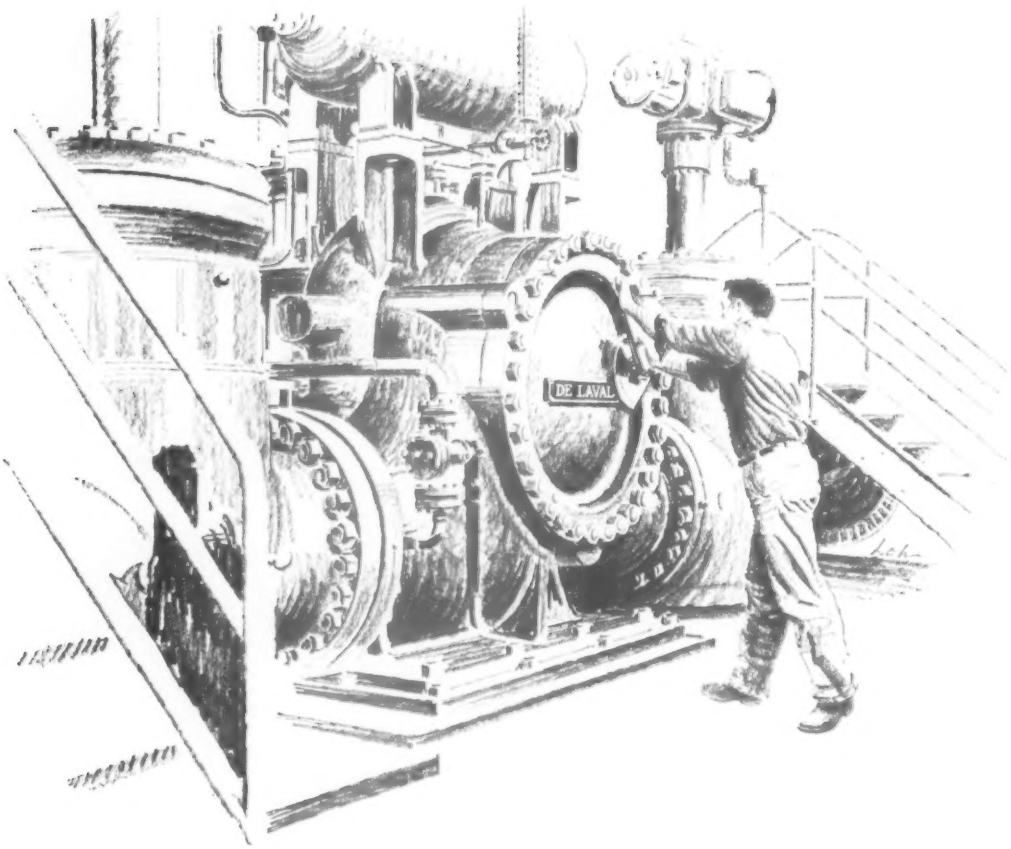
DU PONT
REG. U. S. PAT. OFF.

Better Things for Better Living . . . through Chemistry

DE LAVAL
engineered
flexibility
gives more flow
as pipelines grow

De Laval centrifugal compressors that boost gas through pipelines are a good example of De Laval engineered flexibility. Just two changes in parts — impellers and diffusers — increase compressor capacities and pressure ratios. Fluid flow keeps in economical step with growing demand.

Many companies face problems caused by fluctuating production levels, variable or interrupted operations, steady or rapid growth. To help solve such problems, De Laval engineers maximum flexibility into all of the many products it furnishes to industry.
De Laval Steam Turbine Co., Trenton 2, New Jersey.



MG-DL-100

DE LAVAL • 60 YEARS OF CREATIVITY AND QUALITY

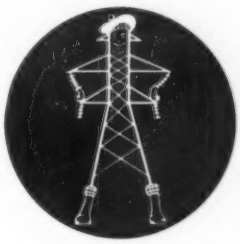
CENTRIFUGAL PUMPS AND COMPRESSORS • TURBINES • IMO® ROTARY PUMPS AND HYDRAULIC MOTORS
MARINE PROPULSION AND AUXILIARY EQUIPMENT • HELICAL AND EPICYCLIC GEARS • TURBOCHARGERS

Electricity does it better . . .

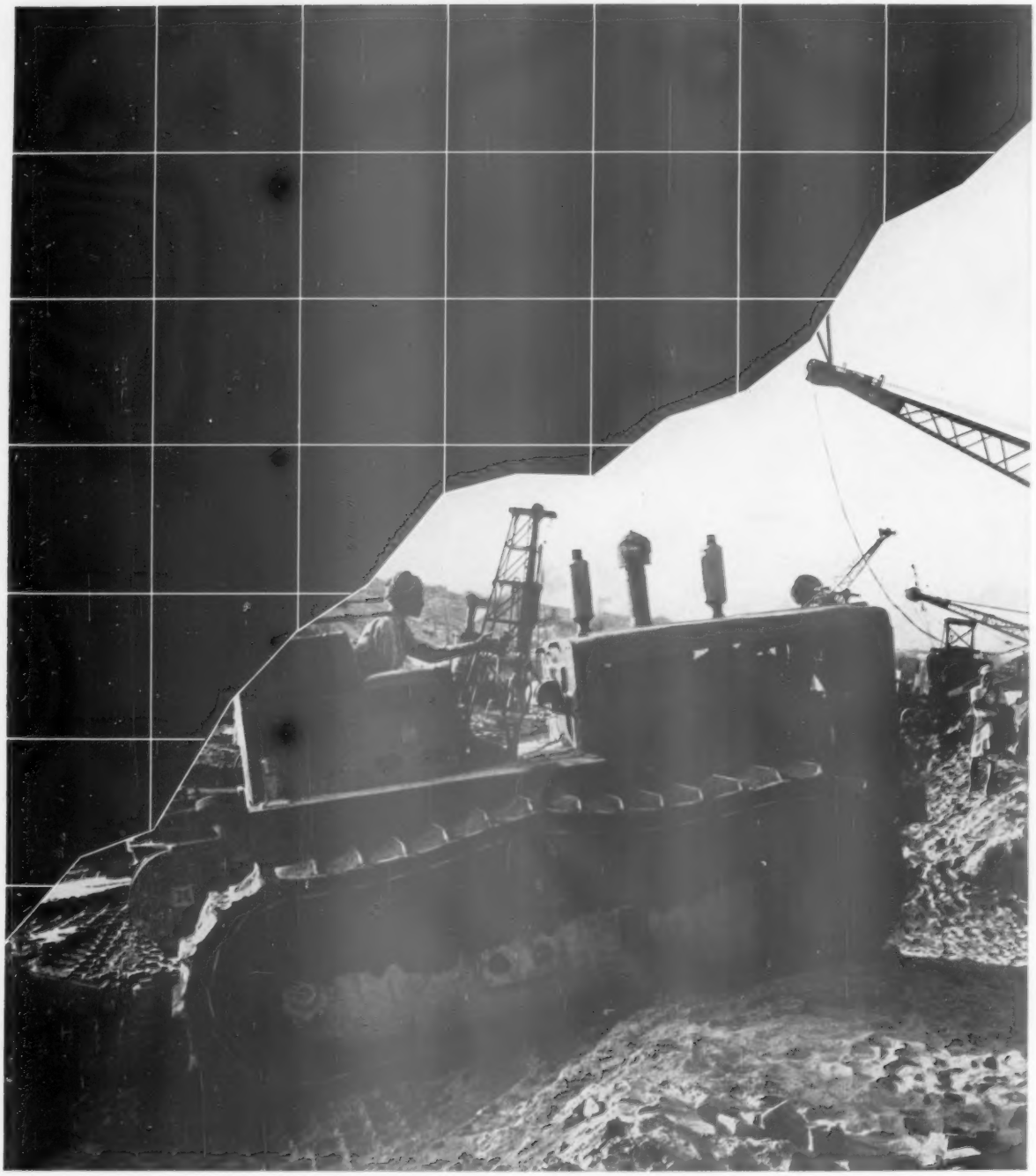
Utility electric power is not only dependable but it offers the advantages of low-maintenance and automatic control to release manpower and cut payroll costs. Whether at a gathering station, water-flooding project, on a pipeline, or in a refinery, utility electric power does every job better and cuts over-all costs to a minimum. For information on possible savings in your operation, consult your nearest Utility Electric Power Company today.

Petroleum Electric Power Association
BOX 35006, DALLAS 35, TEXAS

Utility Electric Power saves money, manpower, maintenance and serves you better automatically



A list of P.E.P.A. members will be furnished on request.



"World tensions present problems, but they can also be signs of growth and development. We are in a period when rapid economic improvement is the urgent goal of every nation. The striving of all peoples for social and industrial development is bound to increase the demand for the abundant low-cost energy provided by oil." *—From the 1960 Annual Report*

Standard Oil Company (New Jersey)

(WHOSE PRINCIPAL U. S. OPERATING AFFILIATE IS HUMBLE OIL & REFINING COMPANY)

Photographed at DX Sunray Oil Company, (Tulsa Refinery)

For a higher yield per dollar—Aerocat Triple A

Why more and more refineries are increasing efficiency and cutting costs with this 25% Alumina Catalyst. AEROCAT TRIPLE A® Cracking Catalyst, the first commercially successful 25% alumina catalyst, is still setting records. Its combination of extremely high activity and unusual stability provide premium cracking efficiency, high equilibrium activity, increased conversion at lower temperatures, or (compared to conventional, low alumina catalysts) reduced catalyst usage at severity levels.

Yet, with all its efficiency, AEROCAT TRIPLE A can actually save you money, compared to other synthetics of comparable performance—particularly where low catalyst turnover is possible. It yields *more* gasoline; it measurably increases octane rating, and with no increase in stack losses of the catalyst itself. The increased output takes place at the expense of a lower dry gas yield.

Isn't it time you investigated what AEROCAT TRIPLE A can do for *you?* Your Cyanamid salesman—"The Man with the Golden Rule"—will be glad to cooperate, for sharing his skill and experience with refiners is a most important part of his job. Why not call him *now?*

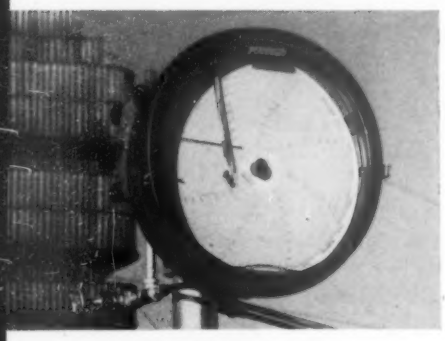
Basic in catalyst chemistry

CYANAMID

AMERICAN CYANAMID COMPANY • REFINERY CHEMICALS DEPARTMENT • 30 Rockefeller Plaza, New York 20, New York

Remarkable performance record — Foxboro T/37 meter operates 28 months without maintenance on corrosive sour gas. Mr. K. A. Sorenson, superintendent at Shell Oil Co.'s Bryan Gas Plant, Skellytown, Texas, checks the reading.

28 months on sour gas – and not a minute's maintenance for Foxboro's T/37 "dry" meter!



Unmatched stability in a dry flow meter! No zero drift. Complete overrange protection. Foxboro T/37 meter with unique Type 316 stainless steel high-sensitivity element, provides high-accuracy, mercuryless flow measurement over wide range of differential pressures and static pressures up to 2500 psi.

A Foxboro T/37 "dry" meter has just completed a 28-month continuous service test on sour gas at Shell Oil Co.'s Bryan Gas Plant, Skellytown, Texas.

During the test period, the meter required absolutely no maintenance. A complete inspection at the end of the test showed the meter was still as good as new. Not a sign of corrosion, wear, or pitting. And absolutely no zero shift under ambient temperature and pressure tests.

Moreover, a calibration check proved the T/37 to be well within the guaranteed accuracy of ½ of 1%.

As Mr. K. A. Sorenson, superintendent of the gas plant, puts it: "We find the T/37 dry meter ideal for this service. Performance is excellent, and highly accurate."

The T/37 is a meter you should know more about! Ask your local Foxboro Field Engineer for complete details. Or write for Bulletin 7-15A. The Foxboro Company, 606 Neponset Ave., Foxboro, Massachusetts.

FOXBORO

REG. U. S. PAT. OFF.

Now one O·C·T well head meets every need

O·C·T's TC MULTI-HEAD HANDLES TUBING or CASING, SINGLE or MULTIPLE COMPLETIONS

O-C-T's versatile TC Multi-Head helps you reduce your well-head inventory because you can use it on practically any well.

The TC Multi-Head suspends either tubing or casing. It accepts 13 different hangers for single, dual, or triple completions. These hangers provide either threaded or slip-type suspensions. All hangers for the TC Multi-Head can be furnished with O-C-T-Otis back pressure valve grooves.

The TC Multi-Head saves rig time because you need not replace it to change your completion plans. Just select the right hanger to meet your needs.

Complete control can always be maintained because all hangers pack off completely when landed. No packing or plastic sealer is added after blowout preventers are removed.

A full-opening 6-inch TC Multi-Head is available that permits running a 6¾-inch bit through 7⅝-inch casing.

See your O-C-T representative for complete information on the TC Multi-Head.

where progress is a daily practice

Several technical brochures are now available on O-C-T equipment, and others are being prepared. Write us for the brochures you want. Those now available include "O-C-T Flow Controls and Chokes," "O-C-T Independent Well Head Equipment," "O-C-T Tubingless Completion Well Head Equipment," "O-C-T Well Head Equipment for Storage Wells."

O·C·T

OIL CENTER TOOL CO.

SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

Address Export Inquiries for All Countries to
P. O. Box 3091, Houston, Texas.

Now...dependable bubble-tight shutoff

Double R/L
Plus...all of these features
LINER LOCKS WITHIN BODY. SNAP-IN REPLACEMENT INSTALLED IN MINUTES
"O" RINGS FOR POSITIVE SEAL
ELIMINATES NEED FOR GASKETS
SELF-LUBRICATING GLASS FILLED TEFLON BUSHINGS
LINERS AVAILABLE IN A WIDE RANGE OF MATERIALS
DISCS AND BODIES IN ANY CASTABLE ALLOY. SIZES 2" to 12"
The Fisher-Continental *Double R/L* Butterfly Valve

Can be used for on/off or throttling control, using manual and/or power actuators. CONTINENTAL EQUIPMENT COMPANY (a Division of Fisher Governor Company), Coraopolis, Pa.

Write for Bulletin 91

If it flows through pipe anywhere in the world ...chances are it's controlled by.....

FISHER® Controls SINCE 1880

COORS CERAMICS CUT COSTS

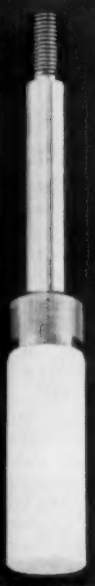
You, Too, Can Cut Pump Maintenance Costs By Using Coors Ceramic Plungers. Coors Ceramic Plungers, 2-¾" diameter, were installed in this GASO Figure 3466 Horizontal Triple Plunger Pump when it was placed in water flooding service June 1, 1957, operating at 225 RPM against 900 PSI. In 1960, after 1,504,320 barrels of salt water had been discharged, it was found that only $73.89 had been spent on maintenance. This expenditure was for repacking the plungers three times—after 7-½, 15 and 27-½ months' service. The original Coors Ceramic Plungers are still in regular service in this pump. All leading builders of plunger pumps have Coors Ceramic Plungers available—normally from stock. Please ask the builder of your pump for Coors Ceramic Plungers to help you cut pump maintenance costs.

Coors

ALUMINA CERAMICS

Coors Porcelain Company

600 NINTH STREET • GOLDEN, COLORADO



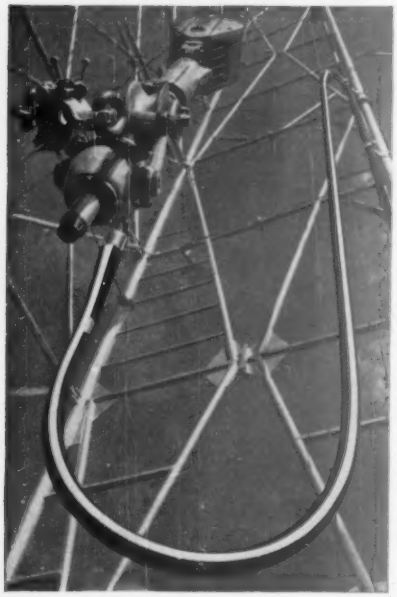
GASO PLUNGER
OF COORS CERAMIC

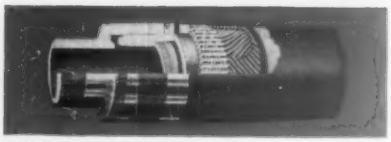
Keep jobs moving with THERMOID Big T Hose

Thermoid hose handles the big, important petroleum jobs with ease. Reliability of product and availability on a moment's notice keep jobs on schedule by holding down-time to a minimum. Ask your Thermoid Big T distributor for the specific hose you need to fill any application in the petroleum field. For information, write Thermoid Division, 200 Whitehead Road, Trenton 6, New Jersey, or phone JUniper 7-3000.

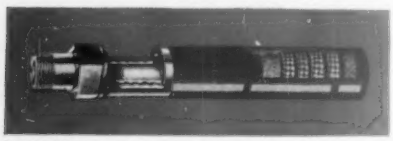
Quaker Thermoid

ROTARY HOSE for slim hole or production drilling



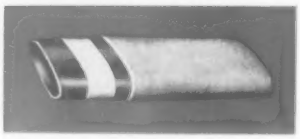


POWERFLEX GOLD STRIPE. Proof-tested to 7,500 lbs. pressure for safe operation at any pump pressure, with plenty of reserve strength to prevent blow-outs. Extra heavy abrasion-resistant cover. Sizes 2½" to 4".

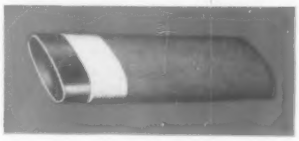


TRIOFLEX. Cover of tough, black, oil and grease resistant synthetic rubber specially compounded for maximum service under all weather conditions. Unusual flexibility and resistance to kinking permits coiling in 36" coil. Sizes 2" to 3".

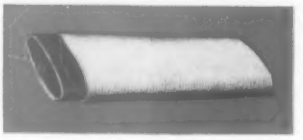
FIRE HOSE for protection of ship and shore installations



PORTER D. J. DELUXE. Double-jacketed 100% synthetic hose designed specifically to resist mildew and rot . . . can be repacked wet, ready for immediate use. First bonded all-polyester fiber double jacket. Test pressure 600 p.s.i. Lengths to 50'. Size 1½"-2½".

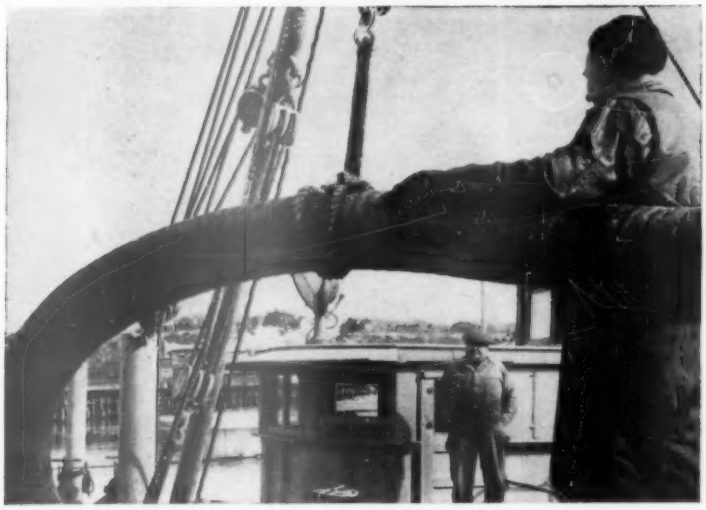


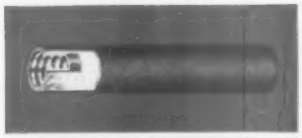
PETROCHEM. First hose designed specifically for oil and chemical industries. It is 100% polyester fiber jacketed for high pressure service under oily and abrasive conditions. Resists heat to 300°F. Sizes 1" to 2½".



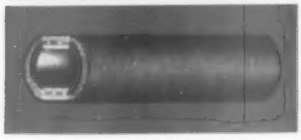
SUPER-QUAFLEX. Constructed with an all-neoprene tube that is completely oil resistant. Lightweight, flexible and easy to handle. Will not kink and can be recoiled with a minimum of effort. Factory Mutual approved in 1½" and 2½" sizes; 50', 75' and 100' lengths.

SUCTION AND DISCHARGE HOSE for oil and gasoline





POWERFLEX. Designed for conveying aromatic solvents. Guaranteed for 2000 hours of service. In sizes 3″ through 12″.

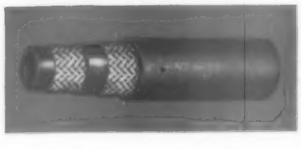


EBONITE. Multiple plies of strong, closely woven heavy-duty duck, frictioned with high grade rubber compounds for firm bonding and high burst resistance. Lengths to 50′; sizes 3″ to 12″. (Also available in "Quaflex" grade with nylon cord reinforcement.)

BLOWOUT PREVENTER HOSE all pressure operated units

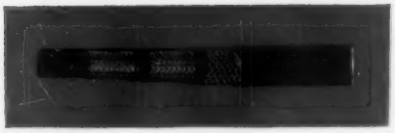
Wire braid construction and special pressed on couplings provide more than ample safety margin for handling any pressure found in operating blowout preventer equipment. In 1″ 2-braid or 1¼″ 3-braid.

GENERAL SERVICE HOSE for varied jobs

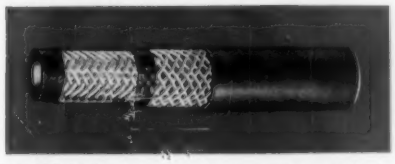


VERSICON. Most versatile molded hose ever offered. Particularly recommended for air-operated tools in general industrial applications. Suitable for water, oil, grease, solvents or sprays. 22 sizes from 3/16″ to 1½″.

STEAM HOSE for petroleum field service

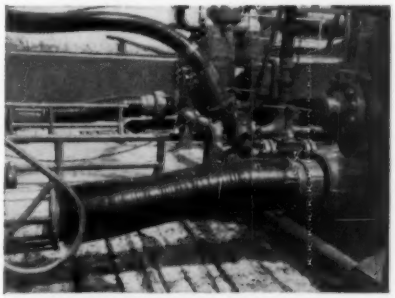


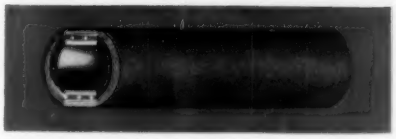
SUPER-IRONSIDES. For extra heavy service in refineries and oil fields. Designed to maintain full flow of saturated steam up to 388°F. at 200 lbs. operating pressure. Kink-proof and flexible. Steel braid reinforcement provides static dissipating feature. Black cover of synthetic compound is resistant to heat, chemicals, abrasion and weather. Lengths to 50′ in ½″ to 2″ sizes.



IRONSIDES. A general purpose hose that handles saturated steam up to 368°F. at 150 lbs. operating pressure. Braid steel wire construction with steel wire braid reinforcement imbedded in heat-and-chemical-resistant synthetic rubber. Withstands heat, chemicals, abrasion and weather. In lengths to 50′ in ⅜″ to 1″ sizes.

SLUSH PUMP SUCTION HOSE for heavy duty pumping





MUD FLO. Thick inner tube firmly bonded to a strong, open-weave breaker fabric. Heavy galvanized round wire reinforcement prevents collapse, affords maximum flexibility, absorbs pumping vibration and provides unobstructed flow. Sizes 4″ to 12″.

THERMOID DIVISION PORTER **H. K. PORTER COMPANY, INC.**

200 WHITEHEAD ROAD, TRENTON 6, NEW JERSEY

AT HUMBLE'S BAYWAY REFINERY... IN OIL FIELDS AND PROCESSING PLANTS...

At Bayway Refinery, a workman removes 2" studs from a cracking unit preheater exchanger that has been exposed to 1000°F. temperatures for prolonged periods. On another job, the time required to remove twenty-two yoke and gear bolts from a Chapman gate type valve was reduced from 8 hours for two men to 1½ hours for one man.

Above, blowout preventer covers are tightened to the prescribed pressure with a 1" square drive SWENCH. Because of its precise torsional impact, the SWENCH can be used for precise tightening as well as loosening jobs. SWENCH can be effectively used for many tough jobs in isolated and hard-to-reach places.

SWENCH® MANUAL IMPACT WRENCH

SAVES AS MUCH AS 14 MAN-HOURS ON TOUGH BOLT REMOVAL JOBS

TYPICAL USES . . .

IN REFINERIES

Pumps **Flanges**
Motors **Valves**
Compressors
Vessels **Coolers**
Processing Units
Reactors **Exchangers**
Catalytic Cracking Units

IN OIL FIELDS

Blowout Preventers
Wellheads **Flanges**
Rigs **Slush Pumps**
Valves **Diesel Engines**
Storage Tanks
Butadiene Plants
Pipe Line Companies

AT HUMBLE'S BAYWAY REFINERY, the SWENCH manual impact wrenches are regular tool room equipment, because they have proven that they can quickly, safely and economically loosen bolts and nuts "frozen" by heavy coking, prolonged exposure to high temperatures and corrosion. Typical savings — 14 man-hours on the removal of the yoke and gear on a 50" x 28" x ¾" Chapman gate type valve. Three different SWENCH models are used at BAYWAY — the ¾" square drive, for pump and motor maintenance . . . 1" drive for heat exchanger servicing . . . and the big 1½" square drive for tough bolt and nut problems on huge reactors and processing units. On each job, the right SWENCH wrench saves man-hours, cuts downtime — adds safety to speed and economy.

IN OIL FIELDS and process plants, operators are saving substantially on many tough loosening — and precise tightening — jobs with a SWENCH wrench. Jobs that formerly took two men many hours to do — Christmas Tree makeup and tear down . . . valve and pump repairs . . . blowout preventer work . . . loosening and tightening flanges . . . are now done in minutes by one man with a SWENCH wrench. The completely portable SWENCH wrench needs no outside power or connection — the tremendous torsional impact power is built into the wrench. A SWENCH wrench will save you time and money on practically any tough job. Sizes range from ½" to 1½" square drive, delivering from 250 to 7,000 ft.-lbs. of torque.

Ask your local distributor for a demonstration that will convince you completely, or write:

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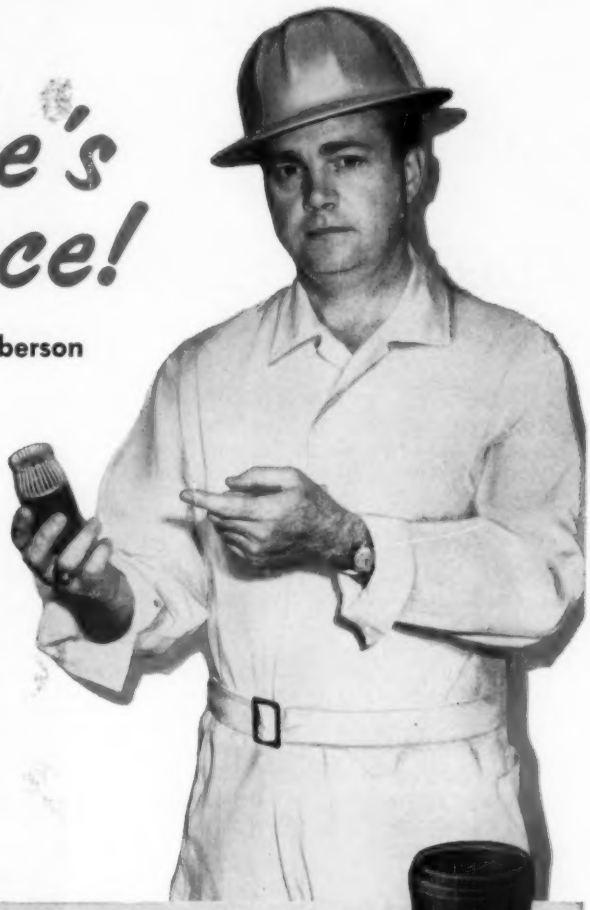
CHOOSE FROM A COMPLETE LINE . . . Another reason why you get more value with Guiberson . . .

Sure, there's a difference!

Dress your swab with genuine Guiberson cups and see for yourself.



You wouldn't wear a tux in a ball game, or overalls at a formal dance — and, for successful swabbing, it's more important that your swab be correctly dressed to suit the conditions. Guiberson, and only Guiberson, offers a selection from nine types of cups and suitable swabs in sizes ranging from 1" through 13⅜".

In most tubing swab jobs, one of three types of well-proved, service-certified Guiberson cups will give superb performance.

Type J

Flexible, strongly reinforced for repeated runs under heavy loads in deep wells.

Type L

More flexible, for medium or heavy loads in wells of any depth.

Type GW

Even more flexible, for light to medium loads in shallow wells, stripping light loads in wells of any depth, and for use in rough or deformed pipe.

Swabbing in oil, water, or acid-water, these cups last and last and lift fluid at a rate that assures a profitable operation. It stands to reason that, with the many variables possible in swabbing, no single type of cup or swab can give maximum performance under all conditions. If you have a special problem, your Guiberson representative will gladly recommend the combination of cups and swab best suited for your particular situation. Supporting his selection is the experience and integrity of the first and foremost swab manufacturer in the world.

Sold by Oil Field Supply Stores Everywhere

THE GUIBERSON CORPORATION
DALLAS, TEXAS, U. S. A.

PRODUCTION, DRILLING AND WORKOVER SPECIALTIES, MOLDED RUBBER PRODUCTS

DRESSER INDUSTRIES INC.

OIL • GAS • ELECTRONICS CHEMICAL • INDUSTRIAL

HAVE YOU THE EDGE IN MEASUREMENT?

Accuracy in flow measurement, from orifice signal to final read-out, depends on many elements. Anything less than the best available system accuracy is too expensive.

The simple orifice plate, a most widely used primary device in measurement, is actually a precision instrument. At Daniel, experienced craftsmen turn out plates, from 1/4" to 60" O.D., which better industry standards.

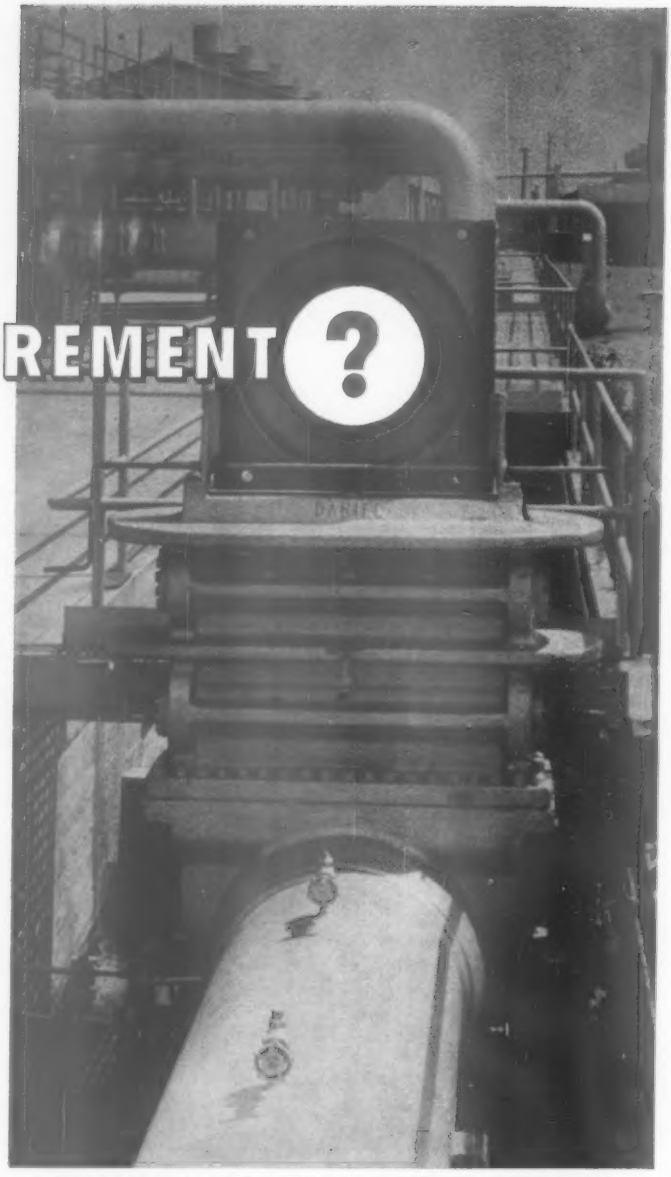
Simplicity of operation and stainless steel trim of Daniel Orifice Fittings are recognized, by measurement men everywhere, as guarantees of better service.

Meter Tubes from Daniel, of special seamless tubing, free from imperfections, provide closest tolerances for the most precise metering applications.

Now all the elements for precision metering are combined into an easy-to-order Daniel Packaged Meter Station.

These custom-designed units provide savings in field assembly costs, reduce order and delivery time, and permit full salvage when desired.

To have the edge in measurement, see your Daniel representative soon, or write direct for full information. You'll be glad you did.



Daniel 30" Senior Orifice Fitting on mainline gas measurement.

from Orifice Plates to complete Packaged Metering and Regulating Stations

Daniel Products are made to Measure!

DANIEL ORIFICE FITTING COMPANY

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223

MARVEL® Treater Helps Good Emulsion-Breakers Work Better

Reduced Operating Costs and Better Oil to Storage Possible with New Visco Mechanical Aid

Visco now has the means to do a thorough dispersion job on emulsion-breaking chemicals, even in viscous, low-gravity oils. It is the Marvel® Treater, a patented mechanical dispersion aid which Visco has available for either lease or sale through your Visco Representative. The Marvel Treater increases efficiency of emulsion-breaking chemicals by insuring that they are thoroughly dispersed in crude oil – and this increased efficiency usually means less chemical is required and/or lower treating temperature.

The Marvel Treater is installed in the flow line so that all fluid going to the treating unit passes through it. Crude enters a slot and baffle arrangement in the Marvel Treater, which completely disperses the emulsion breaker in the oil. However, this dispersion process causes no pressure loss between the inlet and outlet of the treater—it will handle the same amount of fluid as will the line on which it is installed.

Simple to install, the Marvel Treater can be put into place in minutes by field personnel, and is available in sizes to fit, 2, 3, 4 or 6-inch lines.

Field Reports of Marvel Treater Efficiency

Here are a few reports made by Visco Representatives after field-testing the Marvel Treater—testimony as to what the treater can do for you:

Western Oklahoma

"The pumper and superintendent agreed to the installation of a 3-inch Marvel Treater. They have been using butane at a cost of about $100 a month for heating. Two days after the treater was installed, we cut the heat off and the oil has been going to stock better than it ever was. We are getting perfect oil to stock plus a one-degree increase in gravity."

Southern Oklahoma

"They have a 10' x 27' treater that carried 180° heat. The oil was 26° gravity . . . going to stock at 0.8%, and they had to bleed about five inches of water off each tank before they could run it. We installed a Marvel Treater three weeks ago and cut off the heat two hours after installing it. Since then, they have sold a tank a day and the Marvel Treater has not only saved the cost of the butane, which was $25 a day, but has resulted in a 2° increase in gravity, which is 4¢ more per barrel of produced oil."

Operation of the Marvel Treater is explained by a Visco Representative (at left) to a lease operator. The new treating device effects maximum mixing of emulsion breaker chemical with produced fluid, has enabled many operators to reduce heat, cut chemical requirements and produce oil of increased gravity.

Southern Kansas

"An oil company had a new wildcat well producing 19° gravity oil with a pour point of 51°F. Their analysis showed this oil to be 54% asphalt, and the grindout showed 21% B.S.&W. After a two-week treating period the cuts were still going to stock at 2.3%. Marvel Treater was recommended and the customer agreed to a 30-day test. Two days after the Marvel Treater was installed, the oil going to stock ground out 0.4% . . ."

These examples indicate what the Marvel Treater has been able to do for other oil producers. It can probably help you in the same way. Why not call your Visco Representative and talk over your problems with him? Or, write directly to Visco Products Company for details.

VISCO PRODUCTS COMPANY
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A Subsidiary of Nalco Chemical Company
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Visco® ...consistently efficient oil field chemicals

Visco CHEMICALS
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engine power
BY CATERPILLAR

ANNOUNCING TWO NEW LOW-COST, HIGH-HORSEPOWER NATURAL GAS ENGINES BY CATERPILLAR

These new Cat Natural Gas Engines are big in power—for drill rigs, pipeline pumping, compressing stations, separating plants—but low in initial price and in operating costs. They're as thrifty with space and weight as they are on dollars. In fact, the V12 G398 is about the same size as most V8s.

Both come in 7:1 and 10:1 compression ratios. You can operate them with most gaseous fuels.

Both engines use twin turbochargers and divided aftercoolers for greatest performance with top efficiency. They're also available as naturally aspirated gas engines. There's a lot that's new and important about these engines. Your Caterpillar Dealer or your equipment supplier will be happy to tell you about them. Get in touch with them today or write directly to us.

THE 480 HP G379

This new Caterpillar V-8 Natural Gas Engine develops 480 HP @ 1300 RPM. It has an electric set output of 300 KW.

THE 720 HP G398

This new Cat V12 Natural Gas Engine is rated at 720 HP @ 1300 RPM. It has an electric set rating of 450 KW.

CATERPILLAR Engine Division, Caterpillar Tractor Co., Peoria, Ill., U. S. A.

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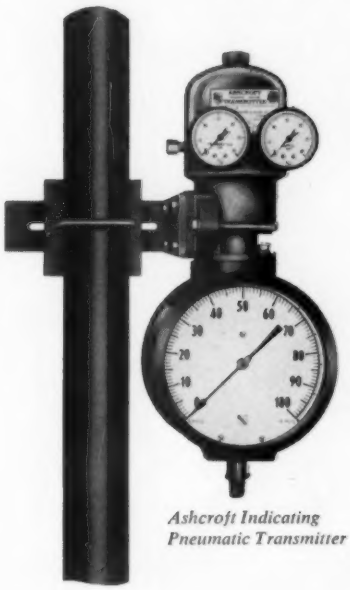
signal

ASHCROFT PNEUMATIC TRANSMITTERS give you a true primary and transmitted signal for indication or control



Ashcroft Indicating Pneumatic Transmitter

action

Now—detect with precision accuracy the slightest change in primary pressure or temperature. Transmit this signal quickly to your indicators or controllers. Ashcroft Pneumatic Transmitters do the job at lowest initial and operating costs.

Full-range, solid-front indicating and totally accessible nonindicating transmitters need no costly high-pressure lines, yet permit complete monitoring of processes in remote areas. For safety's sake, you get full indication even if the air is shut off.

Narrow-span Ashcroft Transmitters are expressly designed with highest sensitivity and repeatability for the most accurate primary signal feed to controllers. You get better control and purer, lower-cost final products.

Only in Ashcroft Pneumatic Transmitters can you get the wide choice of Ashcroft Duragauge Bourdon tubes or American mercury or gas-actuated sensing systems. You also get a time-proven, obstructionproof, force-balance, non-bleed replay for economical, maintenance-free 3-15 psi or 3-27 psi signal transmission. Both indicating and nonindicating *suppressed* types available.

Write for factful Bulletins 360 and 361 or ask your nearby Ashcroft Distributor to help you select the right transmitters and receiver gauges.

MANNING MAXWELL & MOORE INC. M M & M TRADE MARK

ASHCROFT PNEUMATIC TRANSMITTERS

A product of

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Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Latin America: Export Division, Chrysler Building, New York, N. Y.
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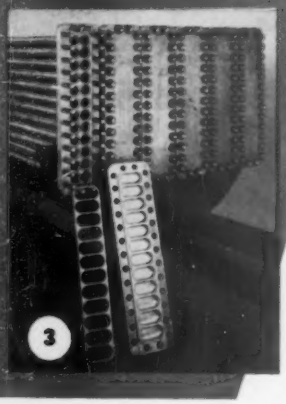
Consolidate all your plant "waste heat" sources with this unique

Vogt multi-stream STEAM GENERATOR

1 This unit has 1700 square feet of heating surface and is designed to generate 13,125 pounds of steam per hour at 150 pounds pressure. Note the six separate and independent circuits of the tube bundle stationary end which is bolted to shell.

2 Tube bundle floating end prior to bolting covers to the independent floating tube sheets.

3 Floating end of the tube bundle consists of six independent circuits each with its own tube sheet, gasket and cover with special integral baffles.



Put unused sources of heat to work by concentrating them in a Vogt Multi-Stream Steam Generator.

The purpose of the design is twofold. First, it is possible to utilize several hot streams if there is insufficient heat recovery in one stream. Second, if one hot stream is used it can be split into several circuits whereby the flow is only one-tube-per-pass. This prevents plugging of tubes when handling fouling or polymerizing liquids.

The design incorporates a number of separate circuits enclosed in a single shell. The circuits are independent of each other and each stream can be separately shut off and cleaned without affecting the operation of the others. Thus the unit can be kept continuously on the line by operating one or more streams.

HENRY VOGT MACHINE CO.

P. O. Box 1918, Louisville 1, Ky.

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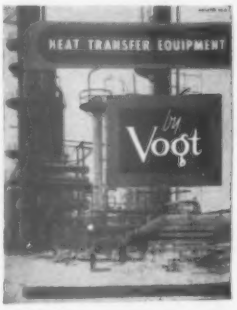
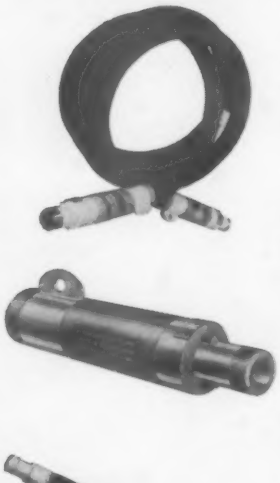
NEW YORK • CAMDEN, N. J. • ST. LOUIS • LOS ANGELES • CLEVELAND • CHARLESTON, W. VA. DALLAS • CHICAGO

Bulletin HE-8 illustrates many unusual as well as standardized types of heat exchangers. Write for your copy to Dept, 24A-XO.



3 important reasons for always ordering GOODALL ROTARY HOSE



1 **You get more use** — Goodall Long-Life Rotary Hose has an exclusive design that provides the strength to withstand torsional twist — thus eliminating the cause of 90% of rotary hose failures. Goodall unconditionally guarantees each hose for one year.

2 **You get the famous Barney Coupling and the Goodall Safety Clamp** — The built-in Barney Coupling is the only coupling stronger than the hose itself. It is positively leakproof. The Goodall Safety Clamp is an integral part of the hose; it cannot catch or restrict the hose, and it gives you maximum safety and easy rig installation.

3 **You get more for your money** — Goodall Rotary Hose costs no more than ordinary hose. But Goodall is the only rotary hose that can be re-used as vibrator hose simply by resetting the Barney Couplings. That's why we say that you get a vibrator hose free* every time you buy a Goodall Rotary Hose.

*Plus a nominal cost for resetting the couplings.

Goodall has been first with every worthwhile rotary hose development.

For extra performance, and extra savings, go Goodall. Goodall Rotary Hose is available through your favorite supply store.

GOODALL RUBBER COMPANY

TRENTON, N. J.

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Stocking Distributors: Texas and Louisiana—Houston Oil Field Material Co., Wilson Supply Company, Hunt Tool Company, Superior Iron Works & Supply Co., Inc.; Oklahoma and West Texas—Iverson Supply Company.

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WITH NO MAINTENANCE
NO LUBRICATION
GROVE VALVES

Whatever the completion: single, dual, triple; whatever the service: master, wing or flow line; wherever the location: prairie, swamp or platform, Grove production valves serve you best. Designed and proved in highest pressure wells, Grove production valves offer exclusive "double-barrier" seal. First—positive metal-to-metal seal between inner seat rings and parallel sided gate; second—protected o-rings that seal and squeegee the gate clean and smooth for fast, easy open and close. For master valve service: Grove standard G-2, Balanced Stem, Dual Block, Recessed Body valves and compact Grove Valv-Pak. For wing valves: G-2's and new compact G-6's. Grove V-2's, VL-2's for flow line service. Don't just look at the selling price! Investigate how Grove production valves eliminate maintenance and lubrication costs!

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GROVE VALVE AND REGULATOR COMPANY

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6529 Hollis Street, Oakland 8, California

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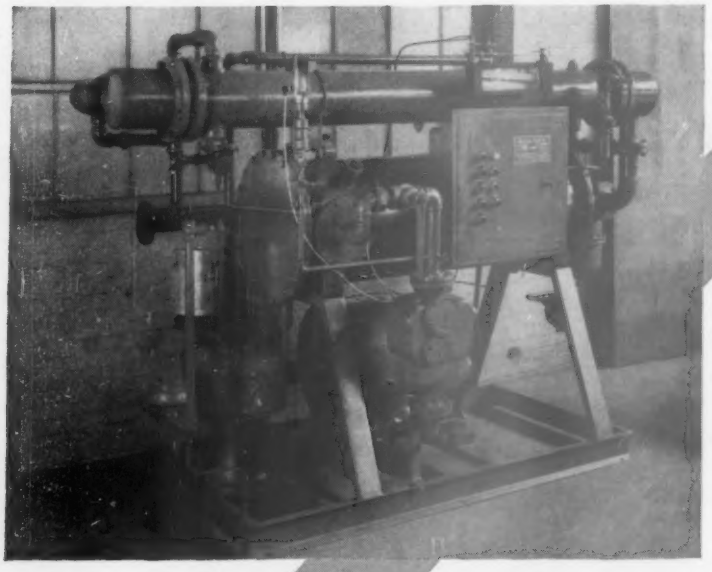
give you 4 basic advantages!



FOR BLANKETING
AGITATING
O_2 EXCLUSION
PURGING
FIRE AND
EXPLOSION
ATMOSPHERES

1 **Constant analysis** is automatic due to the exclusive Kemp Carburetor that pre-mixes gas and air in precisely the ratio you desire . . . maintains it regardless of total demand or pressure fluctuation in the supply line.

2 **Easy start-up** is yours with Kemp Carburetor and external test burner. You test the pre-mixed gas-air ratio *before* it enters the combustion chamber. And electric ignition gets your Kemp Generator off to a time-saving, labor-saving start.

3 **Safety controls** effectively end flame-out danger. Kemp's electronic flame failure control instantly and automatically cuts off gas supply to the carburetor. Moisture and combustion chamber pressure cannot affect this control.

4 **Set it—forget it.** Once you've set the vernier dial on your Kemp Generator you can walk away and forget about it. Kemp's exclusive carburetor keeps your exact gas-air ratio coming hour after hour —as long as you wish—without further checking or manipulation of controls.

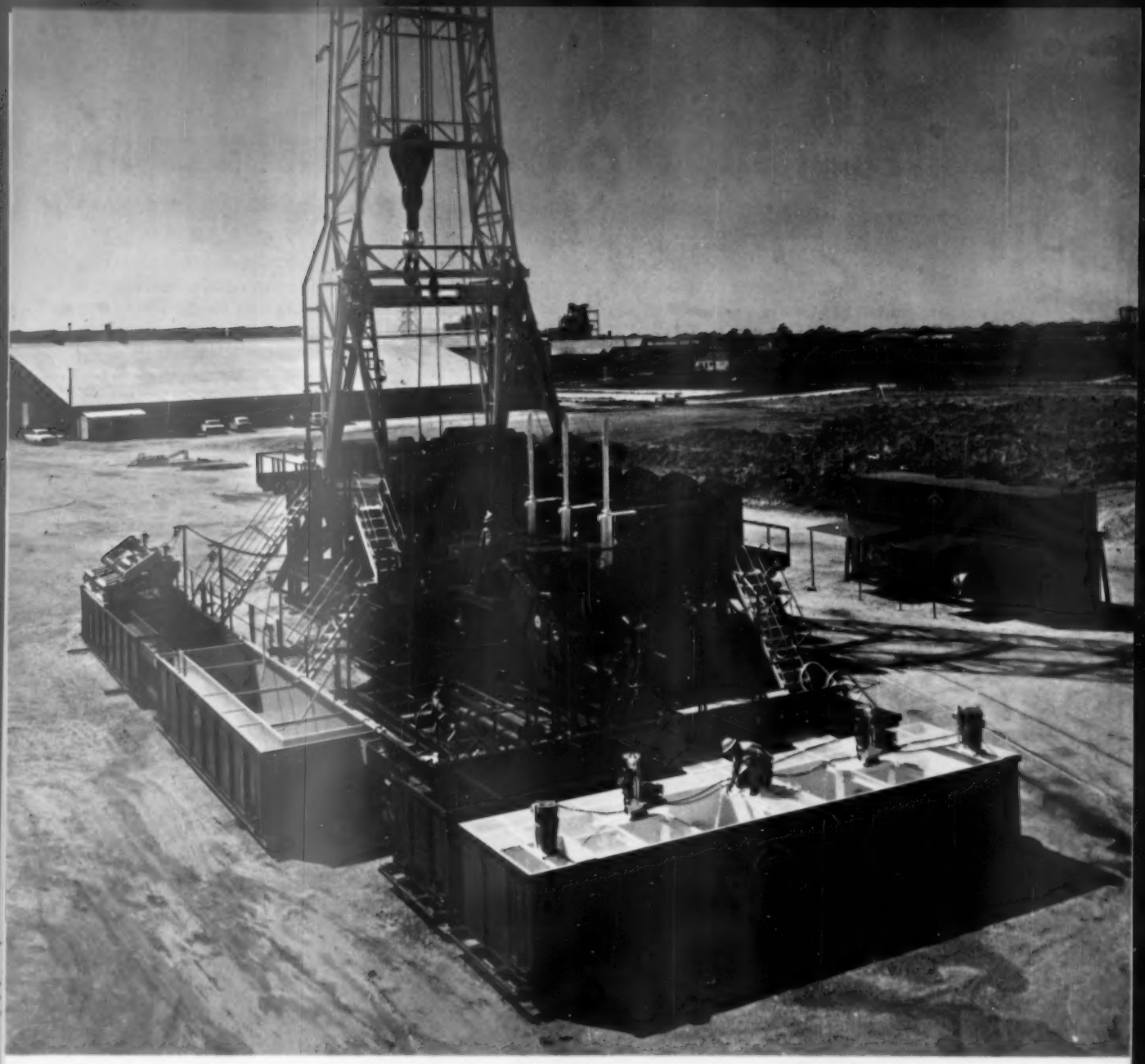
SEE THE MAN FROM KEMP

He is equipped and qualified to advise you on any size and type of generator you may require . . . can also counsel you on dryers and compressors for inert or nitrogen generation systems and heaters. See your C.E.C. Catalog for full listing of Kemp representatives in your area or check your local telephone book. For details on Kemp Inert Gas Generators, write for Bulletin I-10.

It always pays to come to

KEMP
OF BALTIMORE

THE C. M. KEMP MANUFACTURING COMPANY
405 E. Oliver St., Baltimore 2, Md.



SPENDING DAYS TO SAVE WEEKS

When a National Supply drilling rig customer orders a "rig-up," he spends a few days — that can be spared — to save weeks that would be far more expensive to lose.

In a "rig-up," all components of a drilling rig — engines, pumps, drawworks, rotaries, etc. — are completely assembled at the Houston plant before shipment. The rig is then test-operated to make sure everything is in order.

Parts can be color-coded, so their place in the final assembly is immediately apparent. Erection, even at some far-away spot, is thus simplified and speeded. Difficulties and delays are virtually eliminated.

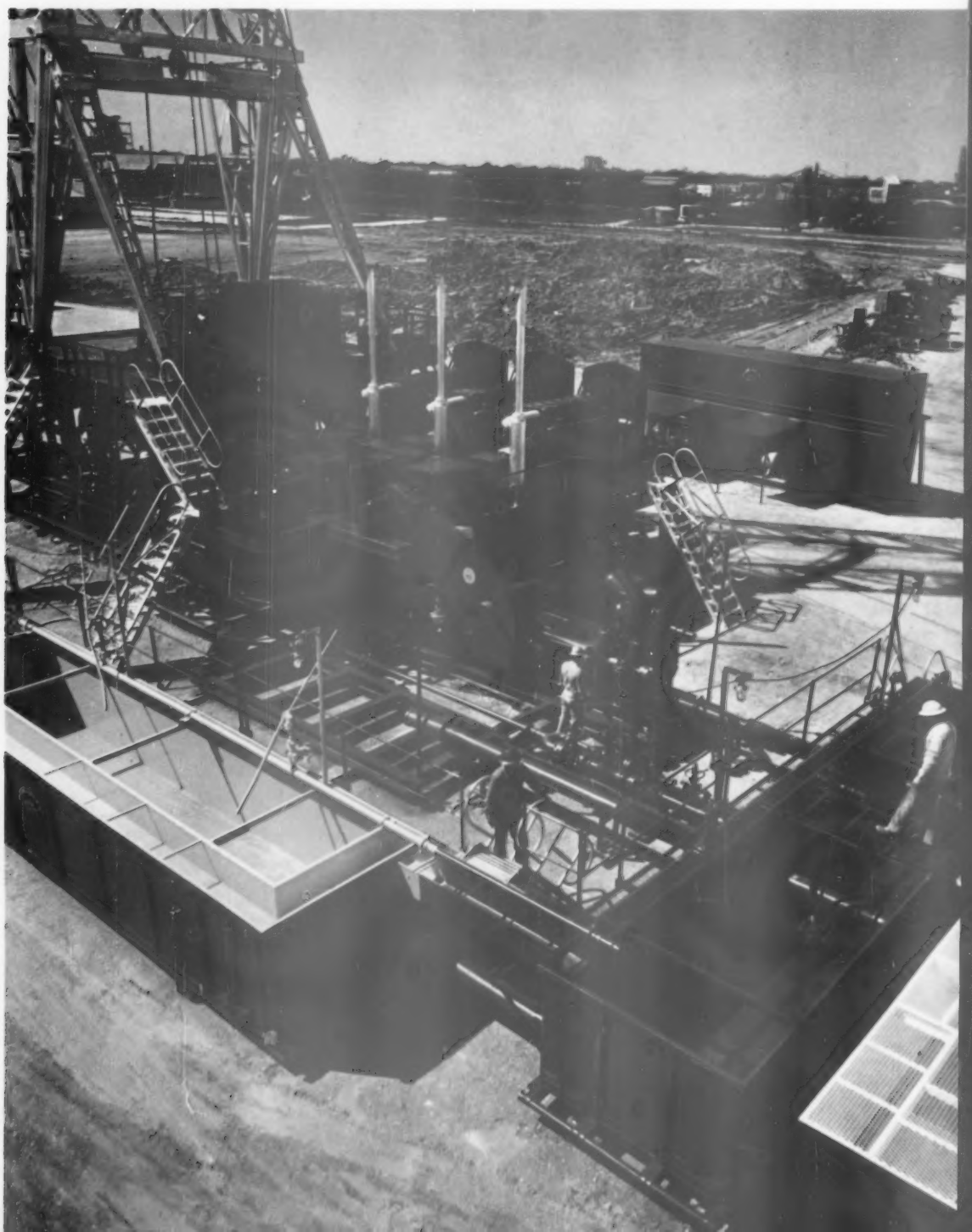
Customers using these National test-assembled rigs report *faster rig-up time than previous field assemblies*. For either domestic or overseas operations, it can be the best insurance you ever bought. Ask your representative for details, or write to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pa.

On next pages:
National Supply rigs

FOUR SOUND, ECONOMIC REASONS WHY

A RIG FOR EVERY NEED. National's complete line of thirteen rigs serves every hoisting and drilling requirement — from shallow wells, to the world's deepest wells, including well servicing and workover. If mobility is a problem, we can furnish truck or trailer mounted rigs, helicopter rigs, rigs packaged into easily airborne units.

EXTRA ENGINEERING. There are no compromises in the design or materials of National rigs. In fact, each one has extra built-in stamina that many National rig users call the "driller's margin." This margin accounts for important performance differences on every well.



NATIONAL RIGS ARE INVARIABLY FIRST CHOICE

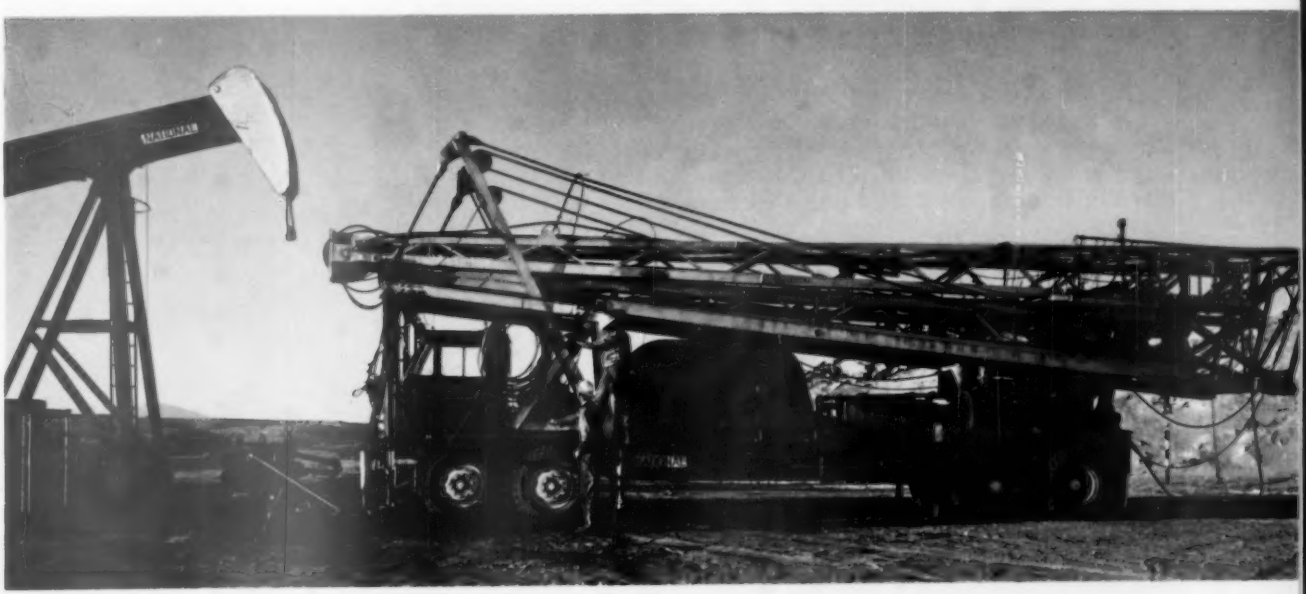
OPTIONAL RIG-UP SERVICE. Before a rig is shipped, it is completely assembled and test-operated, lubricated and adjusted. Related units can be color-coded for fast, simple assembly. If additional companion equipment or services are required, they are furnished immediately.

WORLD-WIDE SUPPLY SERVICE NETWORK. National Supply rigs are now operating around the world. And National Supply has the facilities and representatives around the world to furnish complete, economical technical assistance when needed. This service is one reason why National Supply is the world's largest supplier of oil country equipment.

A National Supply representative will be happy to point out the advantages of each of these rigs, or you can get details by writing to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pa.

NATIONAL DRILLING RIGS

TYPE	INPUT HORSEPOWER RATING	DEPTH RATING (NOMINAL FT.)
T-12	200	1,500 to 3,000
T-20	300	2,000 to 4,000
T-32	400	3,000 to 5,500
T-45	550	4,500 to 7,500
55	700	6,000 to 9,000
80-B	1,000	8,000 to 12,000
110	1,375	11,000 to 16,000
130	1,625	13,000 to 20,000
Helicopter		
4-10	600 to 1,000	5,000 to 10,000
Drive-in Units		
200	150 to 250	
300	250 to 350	
Diesel-Electric Drawworks		
1320-DE	1,625	13,000 to 20,000
1625-DE	2,500	16,000 to 25,000



This National Model 300 Drive-in rig is pulling into a remote location in Colorado for workover service. Both National Supply self-propelled Drive-in rigs, the Model 200 and the Model 300, are carefully engineered for every oil country job from rod and tubing servicing to deep workover.

This Type 55 rig is ready for shipment to Iran after test rig-up at National's Houston plant. This rig has a National drive group with three Superior engines and National torque converters, and a National K-700 slush pump with a National dampener.

Steel

Steel's Symbol of strength, long life, and economy

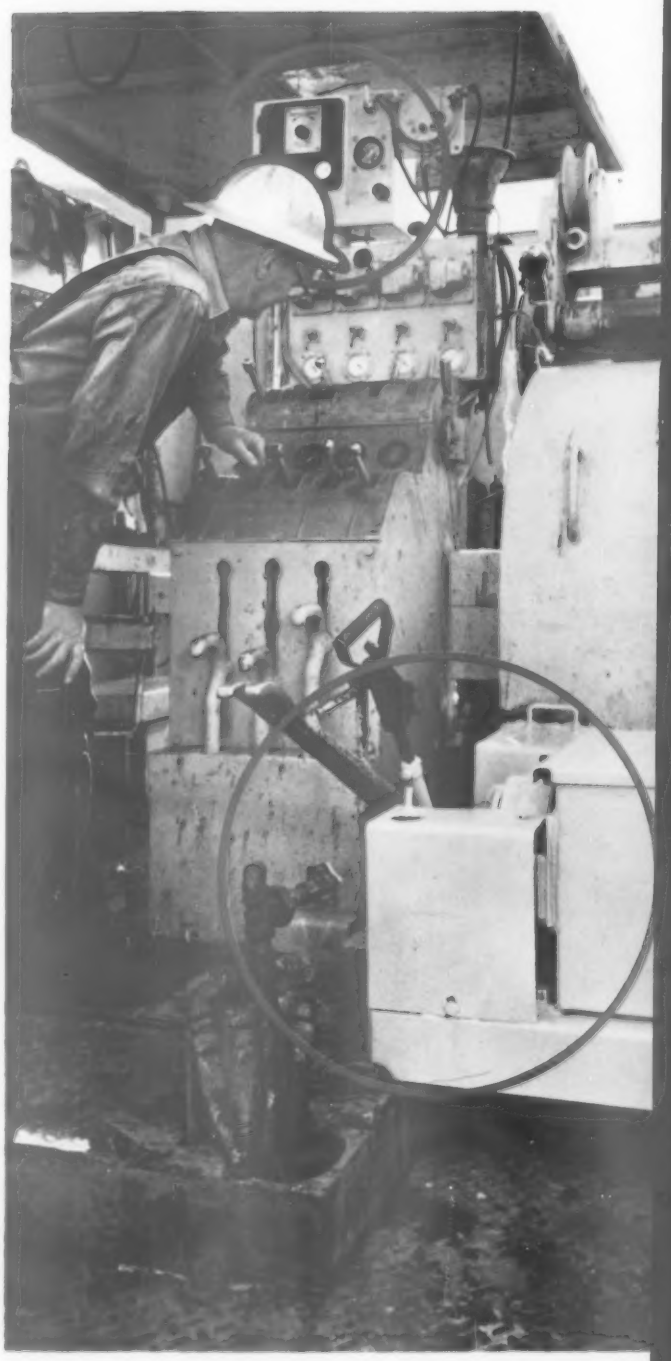
NEW NATIONAL MICROMATIC DRILLING CONTROL CAN LOWER DRILLING COSTS

National's new Model #6 Drilling Control is a rugged, dependable device that automatically operates the drawworks just as the most experienced driller does, and insures the exact penetration rate desired. Usable on almost every new and old drawworks, the Micromatic feeds off the drilling string smoothly and continuously, with maximum safety. Unit is compact, easy to install. Installation time is about six hours and can be done on location.

With the National Micromatic, the drilling string is under complete control at all times; weight on the bit can be increased or decreased at will; and the control can be engaged or disengaged in minutes.

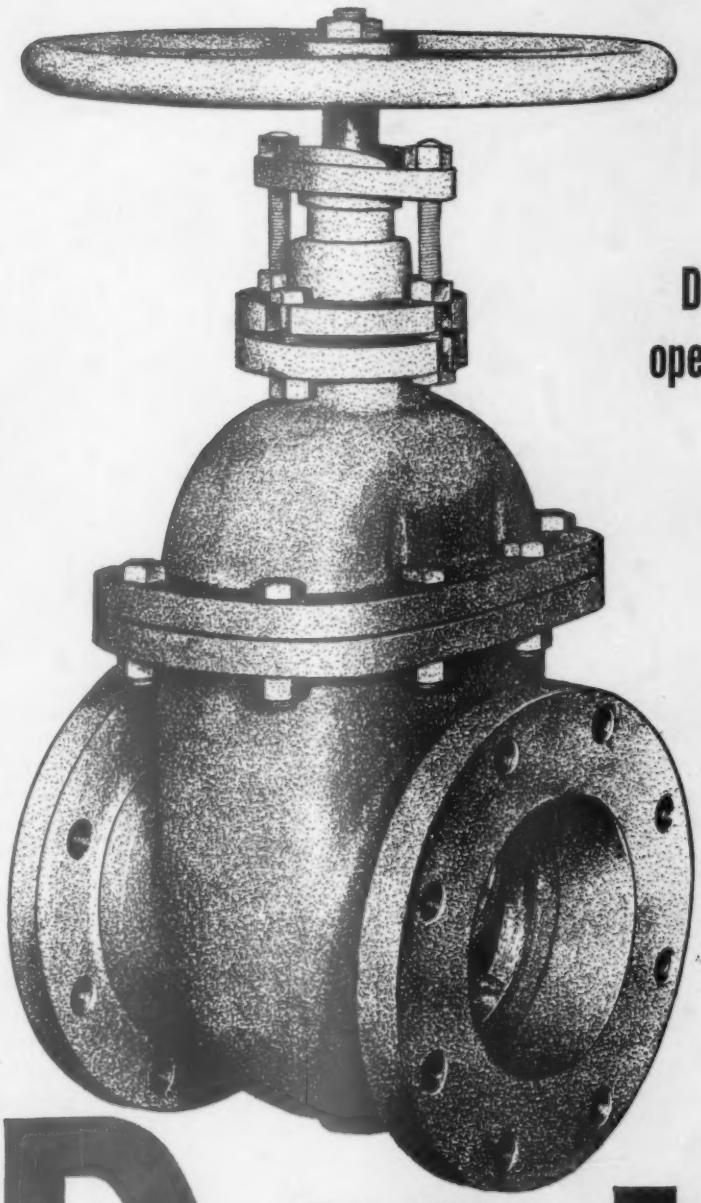
The driller first obtains the desired amount of weight on the bit; snaps and locks the control connecting rod to the brake lever and then opens two air valves in the control cabinet. The Micromatic takes over and maintains the desired weight on the bit.

Ask a National Supply representative to point out how the Micromatic can speed your drilling operations. Or write to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pennsylvania.



Micromatic controls are within easy reach of the driller and can be engaged or disengaged in a matter of moments. Controls are circled in red on illustration at right.

ARMCO National Supply Division



Dependable Darling Gate Valves open fully, close tight—with ease

The fully revolving double disc parallel seat and wedge design minimizes friction, avoids concentration of wear, and automatically compensates for valve seat deflection.

Gate discs are independently hung and free to revolve. They change their seating position at each closing. All working parts are perfectly plain. There are no pockets to collect sediment or prevent free and easy movement.

For assured ease of operation, minimum maintenance, long trouble-free service life, *you can depend on Darling*. Our engineers are always glad to assist you in determining the right valves for your service conditions. Darling Catalog No. 57 gives complete specifications. Write for your copy today.

DARLING VALVE & MANUFACTURING CO.
Williamsport 1, Pa.

Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario, Canada
Vannes Darling-France, 23 rue du Commandant Mouchotte, St. Mandé, France

YOU CAN DEPEND ON

Darling

TRADE DARLING MARK

GATE • BUTTERFLY • CHECK • SPECIAL VALVES • FIRE HYDRANTS

Fischer & Porter's

NEW IN-LINE BLENDING SYSTEMS

MIX FLUIDS RIGHT IN A PIPELINE

Eliminate batch mixing, holding tanks, trimming

Control total quantity ratios by an electronic "memory"

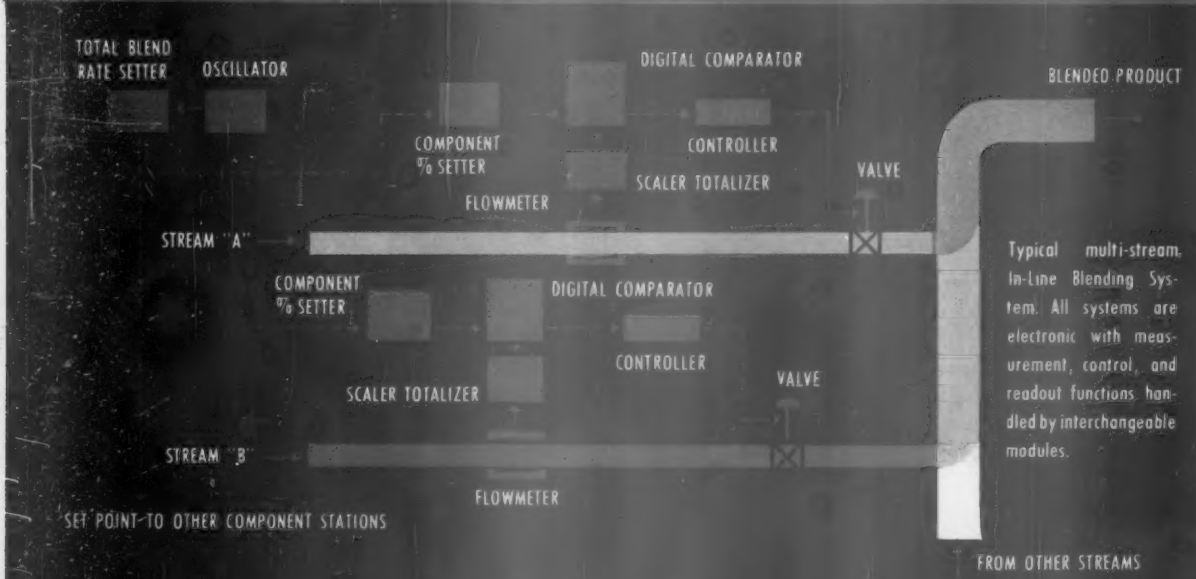
Give a system accuracy of better than ±½%

These new electronic In-Line Blending Systems let you blend two or more fluids — automatically and continuously in a pipeline — with greater accuracy than ever before. Each system combines flowmeters, interchangeable transistorized readout devices and electronic control units to give you a complete, packaged, blending facility from a single source — Fischer & Porter Company.

Each of these unique systems has a memory — that is, it "remembers" how much of any one ingredient has been added to the main stream. Then it goes on to compensate, continuously, for any deviations from the required total blend ratio, whether plus or minus, with an accuracy better than ±0.5%, a repeatability better than ±0.2%. And it is this memory characteristic which obsoletes older flow rate ratio methods.

Result: fast, precise, flexible systems that enable you to control mixing or blending from feed lines to point-of-use — product pipelines, tankers, whatever. You eliminate wasteful batching operations in between. Many types of systems are available, including the blending of two or more streams for petroleum, chemical, food, or other products of processing industries.

A description of your interest will bring you complete technical data. And, let us know if you would like to see a typical system in operation here at the plant . . . Fischer & Porter Company, 3161 County Line Rd., Warminster, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 Jane St., Toronto.



Typical multi-stream In-Line Blending System. All systems are electronic with measurement, control, and readout functions handled by interchangeable modules.

FP FISCHER & PORTER COMPANY

A world-wide Instrument Company with plants in Australia, England, France, Germany, Holland, Mexico, and the United States.

Trinity
LITE-WATE

A Complete Low Density Cement that is

HIGHLY IMPERMEABLE

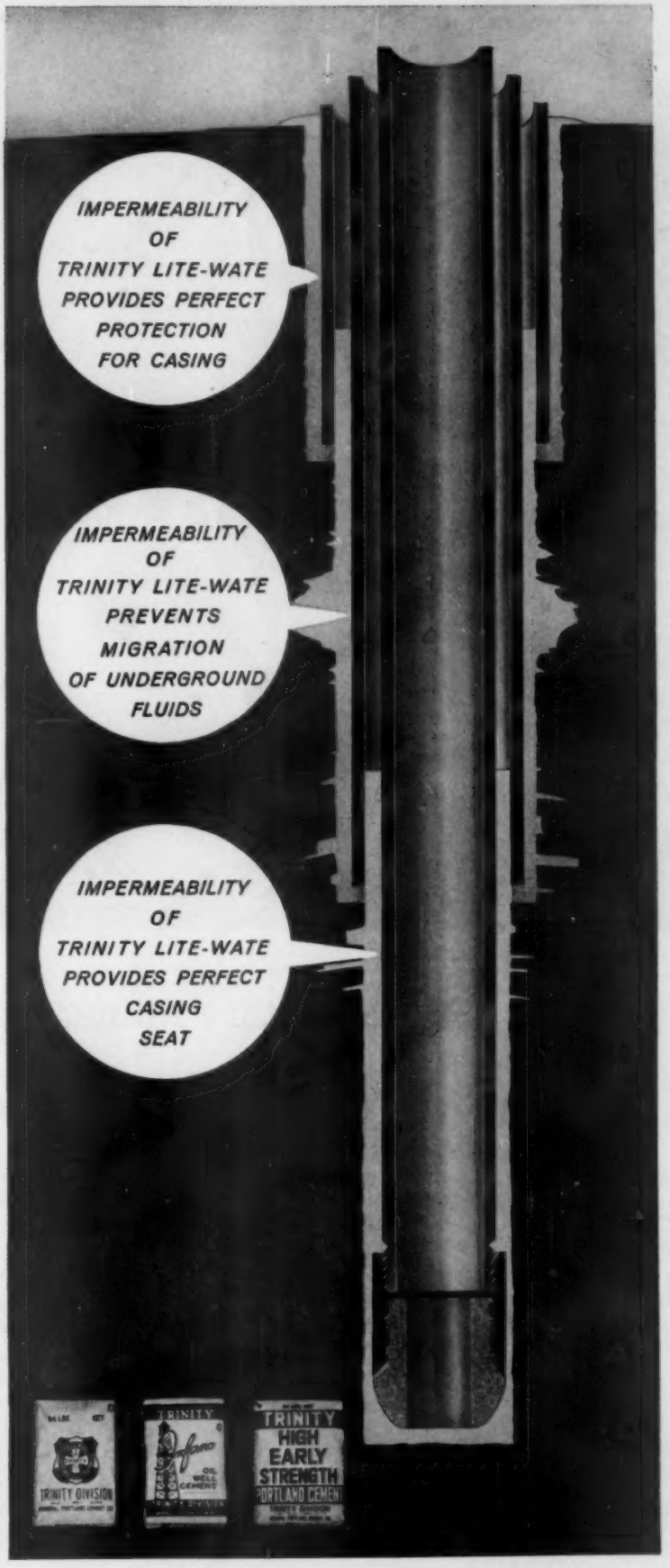
Trinity Lite-Wate fulfills all important functions when placed in an oil or gas well.

PERMEABILITY TEST DATA

All slurries were prepared according to procedures of API RP IOB and cured at 140°F and atmospheric pressure for 72 hours.

Percent Mixing Water	Slurry Wt. Pounds Per Gallon	Permeability Millidarcys*
65	13.66	0.001
75	13.18	0.001
85	12.77	0.001
95	12.44	0.001
105	12.14	0.002
115	11.89	0.003

*A darcy is that measurement of permeability that will permit a liquid having a viscosity of one centipoise to flow at the rate of one milliliter per second through a specimen one centimeter in length and having a cross section of one square centimeter under a pressure difference of one atmosphere. A millidarcy is 0.001 darcy. The permeability of Trinity Lite-Wate cement is expressed in millidarcys.


IMPERMEABILITY OF TRINITY LITE-WATE PROVIDES PERFECT PROTECTION FOR CASING
IMPERMEABILITY OF TRINITY LITE-WATE PREVENTS MIGRATION OF UNDERGROUND FLUIDS
IMPERMEABILITY OF TRINITY LITE-WATE PROVIDES PERFECT CASING SEAT
TRINITY DIVISION
TRINITY
Ofnco
OIL WELL CEMENT
TRINITY HIGH EARLY STRENGTH PORTLAND CEMENT

TRINITY

PORTLAND CEMENT DIVISION
GENERAL PORTLAND CEMENT COMPANY

DALLAS·FT.WORTH·HOUSTON

New IBM Inventory Management Simulator

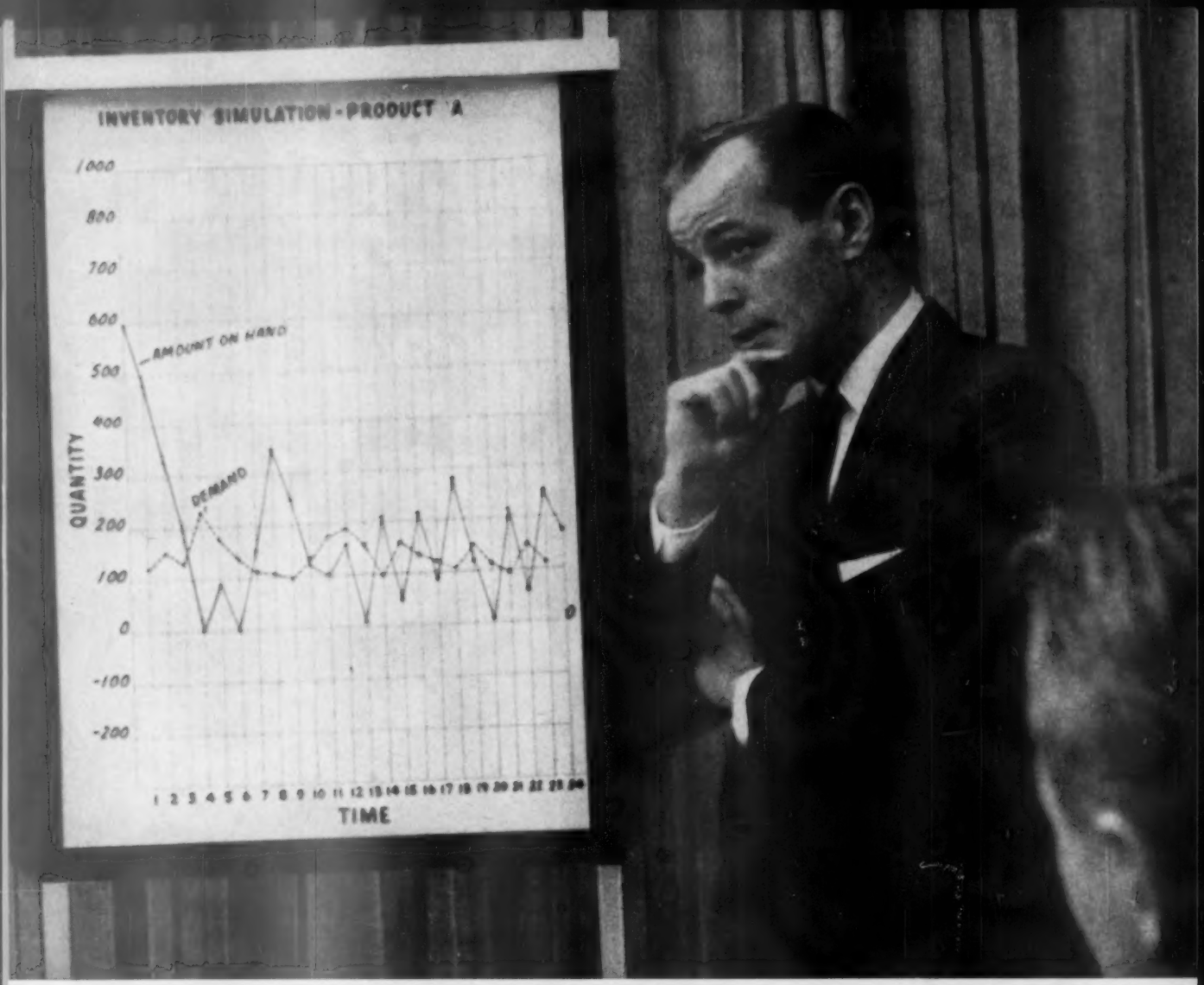
Management pre-tests inventory

How often have you wanted to peer into the future... see the probable results of your inventory policy? **Now you can.** An IBM data processing technique—Inventory Management Simulation—establishes the computer as an invaluable management tool for problem solving and decision making.

This technique lets you test and evaluate alternate plans electronically without disrupting present operations. In effect, it lets you turn *hindsight* into *foresight*.

Simulation is performed by creating within the computer a mathematical model of an inventory control system. Then the model is subjected to various demand situations. In every case, the computer reports what would have happened had this particular system been used to handle each situation. Of course, both the model and the demand factors can be endlessly varied.

Here's the important thing: Through simulation, the trial-and-error method of determining a course of action is performed within the computer—not during the course of your firm's business. This gives you a fast way to test plans under a wide range of conditions before actually putting them



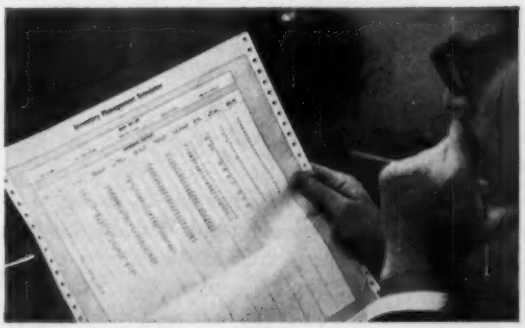
LOOKING AHEAD. Management has run a computer simulation of a proposed inventory plan. Company executives (above) now examine charted results showing how the plan might work, what problems might arise, where improvement might be sought. Print-out sheet (below) from an IBM computer contains facts needed to judge long-range results of a given inventory control plan. Inventory Management Simulation takes much of the guesswork out of planning.

decisions with electronic speed

to use. Unprofitable or inadequate courses of action show up in advance. You avoid them. And you select with confidence the system best suited to your firm's objectives.

Getting started. If you are an IBM customer, you can take advantage of the Inventory Management Simulation Program at once. IBM helps you collect the facts you need... and helps you set up a computer program to analyze them.

Ask your IBM representative to show you how this new technique can uncover *your* most effective inventory policy.



IBM®
DATA PROCESSING

ENGINEERING

NEWS YOU CAN USE ABOUT ENGINE AND COMPRESSOR PERFORMANCE

Why these packing rings are hermetically sealed

No doubt about it, these Cook packing rings have received very special treatment.

Immediately after manufacture, they were carefully inspected, oiled, then hermetically sealed in a plastic bag to protect against dirt, moisture, and damaging corrosive atmospheres. You can be sure that the quality and precision of these Cook rings will not deteriorate before they're put into service.

This "red carpet" handling of a very important item is but another example of Cook's attention to detail — resulting in continued superiority of the finished product.

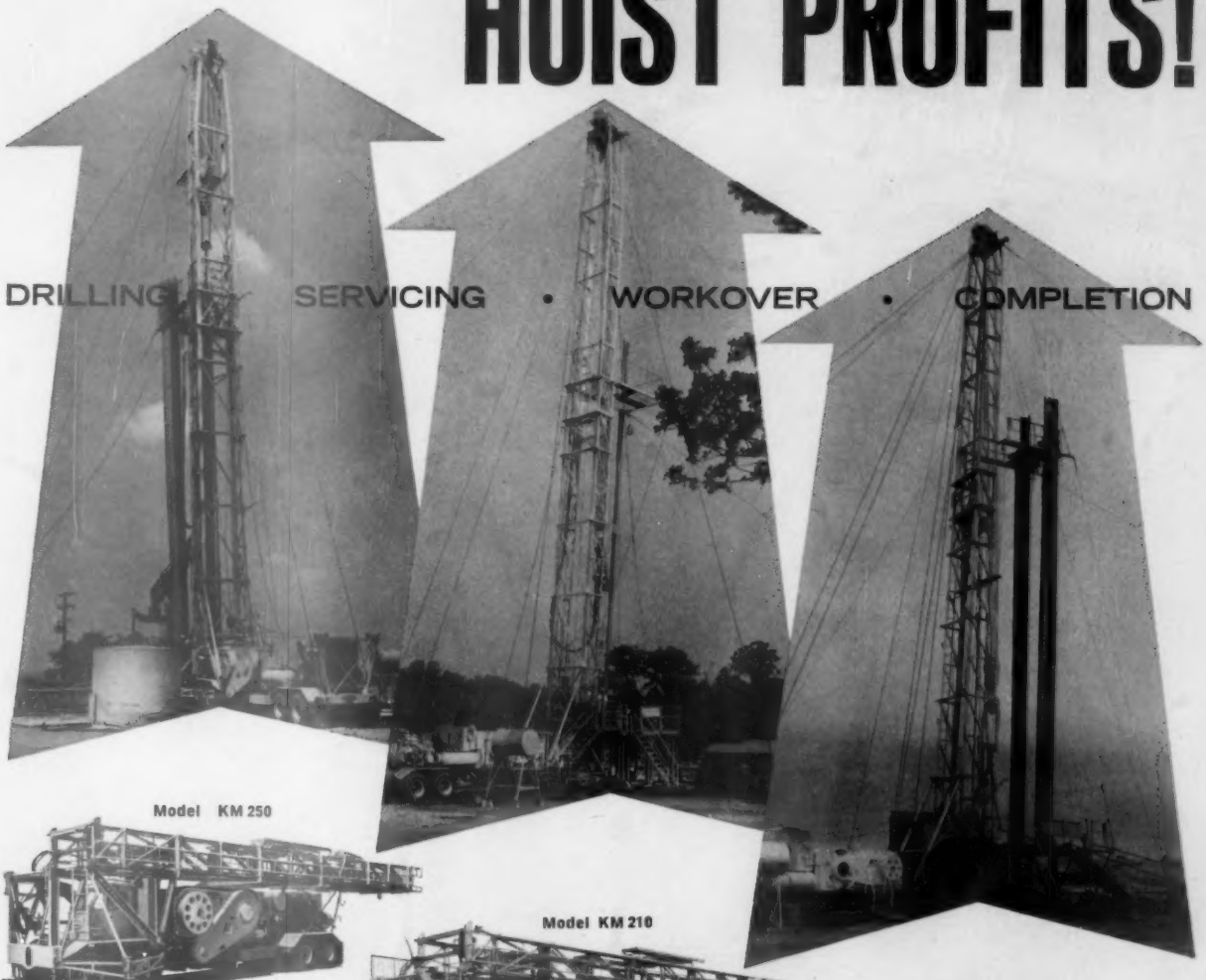
Cook packing rings are precision made to always give you a perfect seal — no matter how difficult the special sealing requirements of your application. Ask a C. Lee Cook representative for complete information. Or, write C. Lee Cook Division, Dover Corporation, 934 South 8th Street, Louisville, Kentucky.

C. LEE COOK

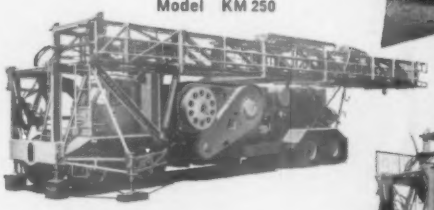
DIVISION OF DOVER CORPORATION

Rings and Packings Since 1888

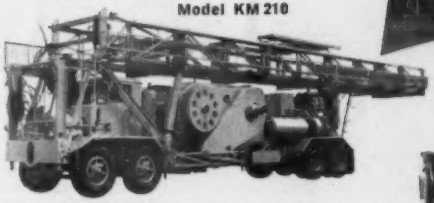
HOIST PROFITS!



Model KM 250



Model KM 210



Model KM 200A

DRIVE A CARDWELL TO YOUR NEXT JOB

Keep profits up! Hold on to good crews! Keep equipment busy! You can do all these things —even in slack times—if you have versatile equipment that lets you do all kinds of jobs.

Cardwell KM210 and KM250 rigs are tailor-made for times like these. They are ideal for medium depth drilling or servicing and workover to 15,000 feet. Being drive-in units, they move fast, rig up quickly, get the job done fast and then get on to the next location. This is particularly true if you also use a Cardwell engineered substructure.

Your costs are low and your profits are high when you use Cardwell iron. Let us give you the full story on these modern Cardwell Drive-in Rigs.

for tomorrow's equipment—see Cardwell today!

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Box 2001, Wichita, Kansas • Cable: ALLSTEEL • Phone: AMherst 7-3311

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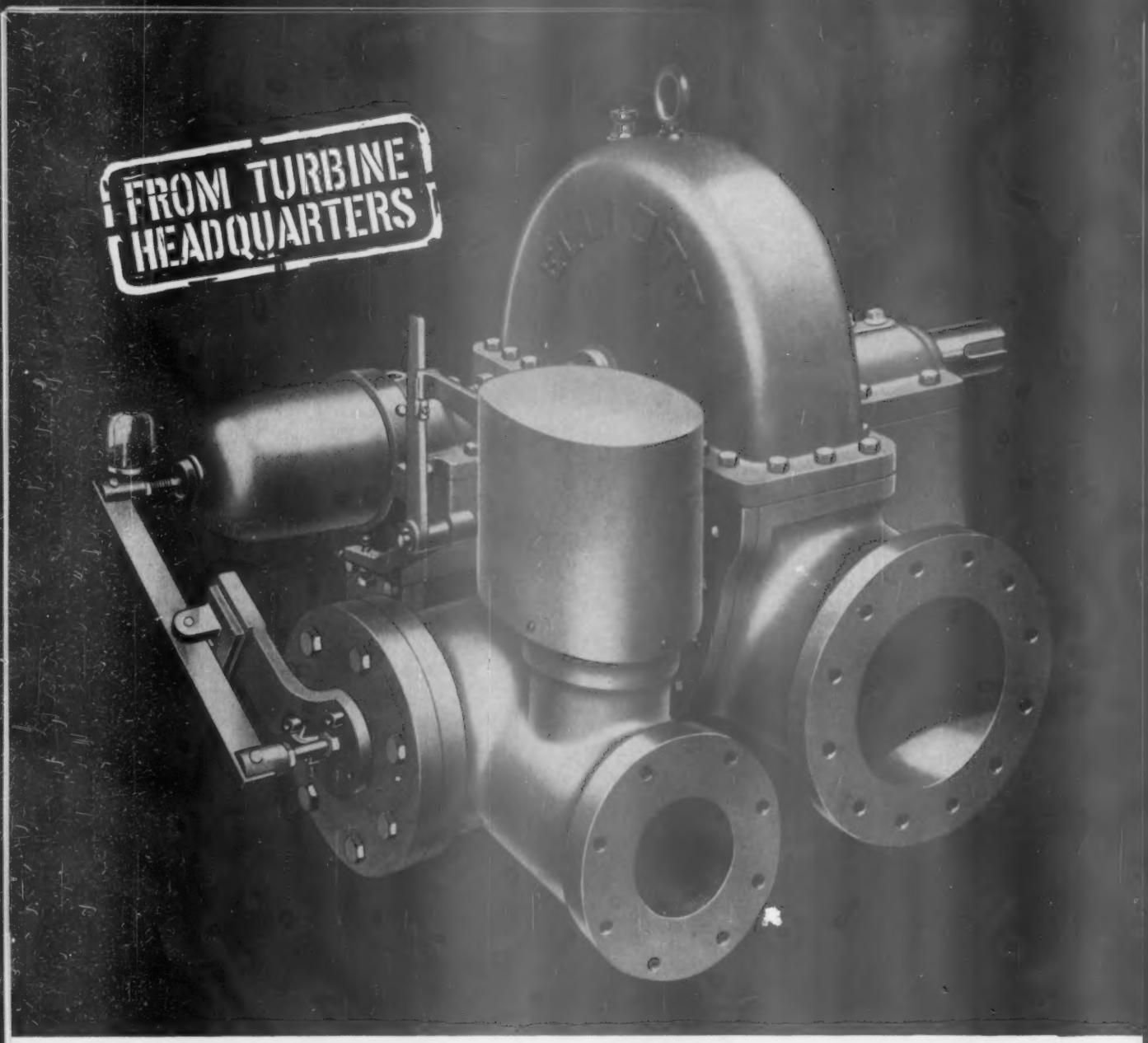

Six marked differences make Elliott turbines a better buy

Why are Elliott YR turbines your best choice for mechanical drives? Some of the reasons are described on the opposite page. These are tangible reasons why you can expect dependable, economical operation with little care or attention.

With more than 50 years' experience in mechanical-drive turbines up to 50,000 hp; with the most complete line of field-proven machines; with engineering and service facilities nationwide: Elliott is clearly "Turbine Headquarters." Write for bulletin H22-D.

TURBINES FOR DEPENDABLE day-in/day-out SERVICE

ELLIOTT COMPANY

GENERAL OFFICES: JEANNETTE, PENNSYLVANIA
PLANTS AT: Jeannette and Ridgway, Pa.; Springfield, Ohio
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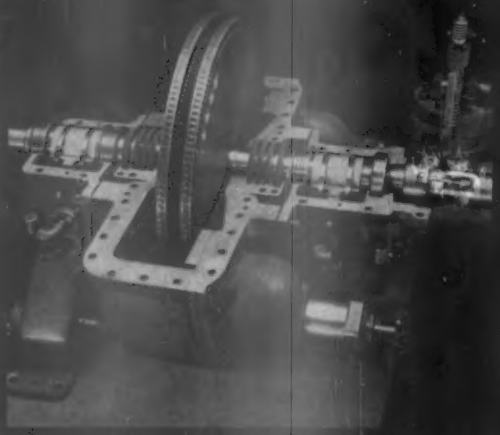
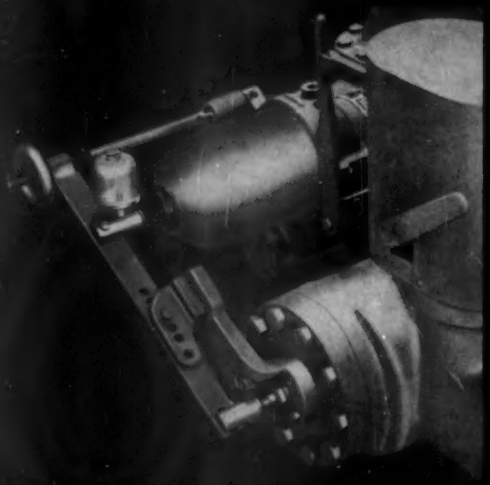
H1-1



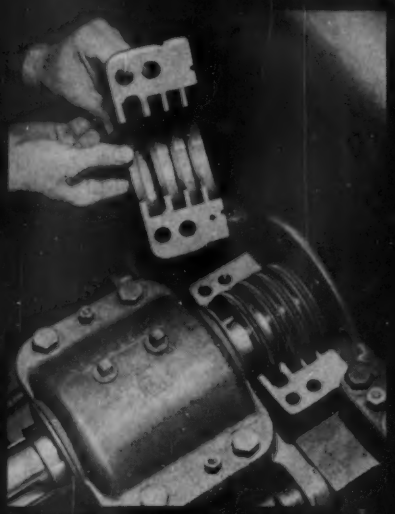
Precise alignment of shaft, through true centerline support, permits smooth and dependable operation at all operating temperatures.



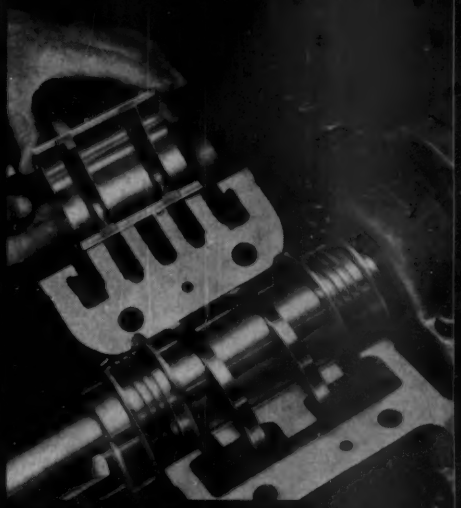
Simple, positive direct-acting speed-governing system is dependable, weather proof, accurate. Separate trip gives positive overspeed protection.

These features mean dependable, economical turbine operation:

1. True centerline support
2. Positive speed control
3. Accessible shaft seals
4. Inexpensive bearings
5. Optional hand valve
6. Full protection

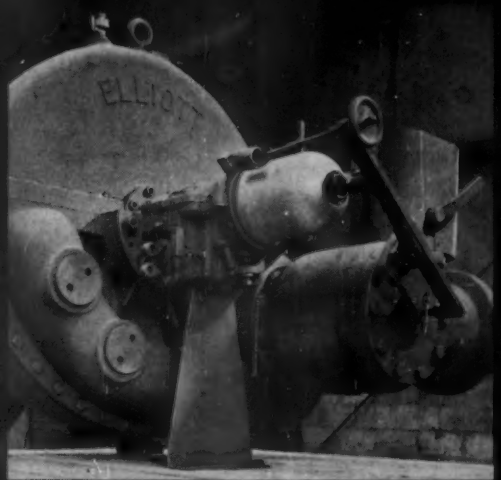


Accessible shaft-seals simplify maintenance and routine inspection. Covers readily removed without disturbing casing.



Inexpensive liner-type bearings readily installed with no scraping, fitting, or adjustment required.

Steam-saving hand valve with pilot, which can be opened against full steam pressure, reduces steam consumption at partial loads.



All-weather protection is standard for Elliott YR turbines. They shrug off heat, snow, moisture, dust or contaminated atmosphere.

They Say—

A clearer lube-oil picture

Dear Sir:

The article, "Refiners' Capacity Still Growing" in the April 3 issue of The Oil and Gas Journal (p. 93) was very informative. I have one change to suggest in future tabulations of lubricating-oil capacity which I feel might give a better picture of this segment of the industry.

The Cit-Con Oil capacity of 10,000 bbl. per day of finished lubricating oil is shown in a note on page 192, but the figure is not included in the total lube-oil capacity of the State of Louisiana and of the United States.

Cit-Con, of course, does not run crude oil, but the crude for the refinery is processed through the Cities Service and Continental Oil refineries in the Lake Charles, La., area.

I suggest that the Cit-Con lubricating-oil capacity be shown in the Louisiana tabulation on pages 172 and 173. A footnote could explain the source of the crude oil. The lubricating oil refining capacity in Louisiana would then be raised from 13,360 to 23,360, both in this section and in the tabulation by states on page 164. The total United States capacity would be raised from 189,870 bpsd. to 199,870 bpsd.

I wish again to state that I found this article very informative and to express my appreciation for the excellent presentation.

E. W. Midlam
Vice President
Cit-Con Oil Corp.
Lake Charles, La.

A guess might pay off

Dear Sir:

Noted your excellent article on the Disturbed belt (OGJ, May 22, "Disturbed Belt Search Revives," by John C. McCaslin, p. 121). Personally, I think if you and I went out and made a location it would be as likely to hit as wells so far drilled.

Due to the jumbled surface beds, later messed up more by glacial ac-

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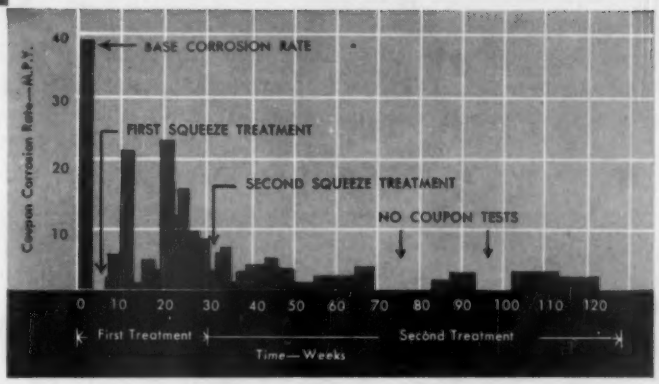


Corrosion history of a West Texas well, showing coupon corrosion rate with time

KONTOL *puts the squeeze on corrosion*

Results at a West Texas well show why the KONTOL* Corrosion Inhibitor squeeze technique is rapidly gaining favor with producers everywhere. Located in Crane County, this well is completed in San Andres pay at 3,500 feet. Production rate is 70 bbl. per day, with just a trace of water. It was decided to try KONTOL inhibitor squeeze after coupon testing showed a corrosion rate of approximately 39 m.p.y., and rods were beginning to pit.

KONTOL *treating is simple*

Inhibitor squeeze treating began by pumping a mixture of 30 gallons of KONTOL dispersed in 100 bbl. of crude oil into the formation through the casing-tubing annulus. This was followed by a 100 bbl. crude oil overflush. Surface pressure was approximately 1,000 psi during the squeeze. Following this treatment, the well was closed for 20 hours.

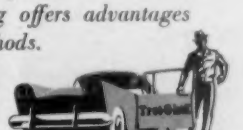
KONTOL *results are positive*

During the first five months following treatment, the corrosion rate varied from a high of 21 m.p.y. to a low of 0.5 m.p.y. For 11 weeks of this period the rate was below 5.0 m.p.y. No equipment failures due to corrosion were reported during the five-month period.

KONTOL *protection is long-lasting*

Six months after original squeeze treatment the corrosion rate was still satisfactory, but it was decided to resqueeze the well to make certain of uninterrupted protection. During the following 90 weeks, coupon tests showed a corrosion rate that averaged 2.0–3.0 m.p.y.—proof of KONTOL's enduring effectiveness.

Ask the Man in the Red Car to explain how KONTOL *Corrosion Inhibitor squeeze treating offers advantages over conventional batchtreating methods. Let him prove why* KONTOL *can be applied more easily and economically, with lasting results.*



*Registered trademark, Petrolite Corporation

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TRETOLITE COMPANY
DIVISIONS
369 Marshall Avenue, Saint Louis 19, Missouri
[illegible] South Pueblo Street, Ferndale, California

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SIMPLIFY TREE CONSTRUCTION . . . AT LOWER COST

W-K-M Cross Type Multiple Completion Gate Valves

These compact multiple gate valves cost less than equivalent components and provide all of the service-proved features of regular W-K-M® Gate Valves such as non-lubricated operation, Teflon* seat inserts for double-tight sealing, and parallel expanding gates for a positive up and downstream seal.

W-K-M Cross Type Gate Valves are available for dual, triple and quadruple completions. Specify W-K-M — at leading supply stores everywhere. Write for Catalog 200. W-K-M Division of ACF Industries, Inc. P. O. Box 2117, Houston, Texas.

*DuPont's tetrafluorethylene resin

When So Much Depends on a Valve . . . Specify W-K-M.

W-K-M DIVISION

ACF INDUSTRIES

tion, surface geology seems worthless.

But the real joker is the varying rock velocities due, in part, to stresses still continuing and, in part, due to sands that are metamorphosed (quartz-like) in some parts of the area.

In some parts of the area, seismic maps have been off from 2,000 to 4,000 ft. in picking top of the Madison. You and I could guess that close.

Al Raymond
Montana Oil Journal
Great Falls, Mont.

Too many rule-makers

"The (Canadian oil) industry's problems today are partly the result of its own investment decisions, and to a great extent, of well-intentioned but impractical government regulations in various phases of the business.

"The oil and gas industry is operating under a variety of regulations imposed by municipal, provincial, and federal governments. It is time, in our opinion, that conflicts among these jurisdictions be reduced in order to secure the economies of operation which are fundamental to the concept of a national oil policy."

W. O. Twaits, president, Imperial Oil, Ltd., in a speech to company shareholders.

Californians can't sit back

"I assume it is unreasonable to expect that a given exploration effort under today's conditions of technology would yield the returns that might have been expected 10, or 20, or 30 years ago.

"This seems to indicate that our techniques for discovering oil, particularly in this area of the country, have not kept pace with depletion of reserves. This is an obvious area for concern.

"We cannot sit back with the soothing assurance that everything is right in California because there is no shut-in production at the moment. As a matter of fact, the present situation where wells are producing at virtually 100% of capacity is probably unhealthy.

"Government and industry must join together in an effort to develop better tools, better techniques, to reverse the trend of discovery that we have experienced over the past 5 years in this state."

John M. Kelly, assistant secretary of the Interior, in a speech to the San Joaquin Valley Oil Producers Association in Bakersfield, Calif.

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

JUNE

11-15 American Society of Mechanical Engineers, summer annual meeting, Statler Hilton Hotel, Los Angeles.

11-15 Air Pollution Control Association, annual meeting, Hotel Commodore, New York City.

11-16 American Petroleum Institute, Division of Production, midyear committee conference, St. Francis Hotel, San Francisco.

12-14 American Petroleum Institute, Division of Transportation, annual tanker conference, Oyster Harbors, Cape Cod, Mass.

12-16 Gordon Research Conferences, petroleum, Colby Junior College, New London, N. H.

13-16 Instrument Society of America, biennial international gas chromatography symposium, Kellogg Center, Michigan State University, East Lansing, Mich.

19-23 Harvard University, School of Public Health, air cleaning institute, Cambridge, Mass.

19-23 Gordon Research Conferences, catalysis, Colby Junior College, New London, N. H.

20-22 National Association of Corrosion Engineers, Greater Boston section, corrosion short course, Wentworth Institute, Boston.

20-24 Canadian Gas Association, annual meeting, Banff Springs, Alta.

21-24 American Association of Petroleum Landmen, annual meeting, Shamrock-Hilton Hotel, Houston.

25-30 American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

26-27 Michigan Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich.

26-July 7 Massachusetts Institute of Technology, summer program on dynamics and control of chemical engineering processes, Cambridge, Mass.

28-30 International Gas Conference, Stockholm, Sweden.

28-30 Instrument Society of America, American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, and Institute of Radio Engineers, joint automatic control conference, Boulder, Colo.

JULY

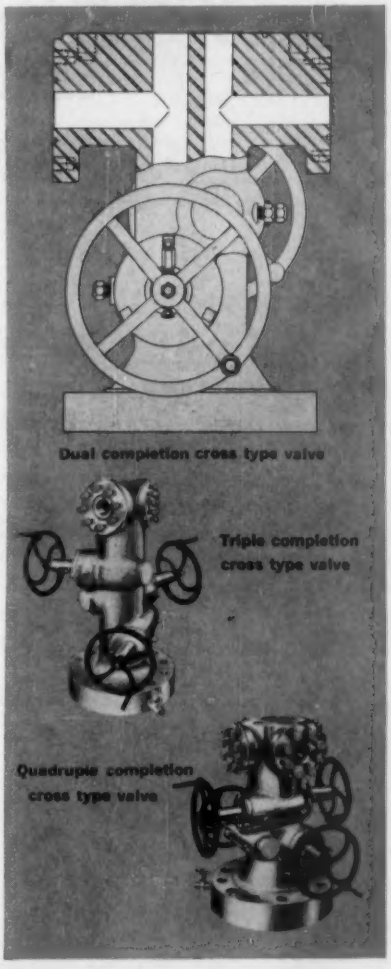
4-7 National Society of Professional Engineers, twenty-seventh annual meeting, Olympic Hotel, Seattle.

6-8 International Oil Scouts Association,

W-K-M
Multiple-Completion Valves

W-K-M Multiple-Completion Valves are built with Teflon seat inserts for dead-tight sealing, pressure-seal bonnets, superfinished stems equipped with roller bearings, and sealing surfaces protected from the flow.

Sizes: 1¾" and 2"
Working pressures: 2000, 3000, and 5000 lbs.



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ACF INDUSTRIES

Adding new dimensions *to engineering*

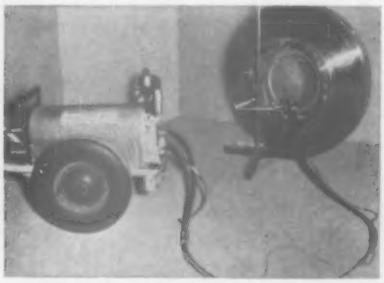
Behind this door...

gamma- and X-rays stop centrifugal compressor problems before they start

We inspect centrifugal compressors *from the inside-out* at our new Non-Destructive Testing Laboratory. Using cobalt 60, iridium 192 or 160-KV X-ray equipment, we look all the way through centrifugal compressor parts to be certain they are free from defects. This extra care in manufacture means extra dependability in the field. It's another reason why users of Ingersoll-Rand centrifugal compressors can expect...and get...more reliable, trouble-free operation.

Controlled from a remote station...gamma rays probe deep...to provide visible internal inspection

At one of 3 test stations, an Ingersoll-Rand radiographer uses remote controls to place radioactive pellets of iridium or cobalt in the exposed position...



...within the thick concrete test cell. The gamma rays penetrate the compressor part and expose the film. The radioactive pellet is then returned to its shielded container.

The developed radiographic view is carefully inspected by I-R metallurgists to be certain that the part is free from defects. Radiography is one of many non-destructive testing methods used by Ingersoll-Rand.

THE WORLD'S MOST COMPREHENSIVE COMPRESSOR EXPERIENCE

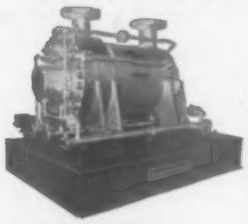
Ingersoll-Rand®
260A12 11 Broadway, New York 4, N.Y.

Why Ingersoll-Rand can supply EXACTLY WHAT YOU WANT in a Centrifugal Compressor

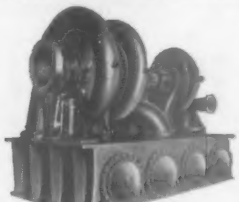
MORE TYPES AND SIZES to choose from

Single-Stage Units
Pressures to 1000 psi
Capacities to 700,000 cfm

Multi-Stage, Horizontally Split
Pressures to 800 psi
Capacities to 200,000 cfm



Multi-Stage, Vertically Split
Pressures to 5500 psi
Capacities to 20,000 cfm



Intercooled 100-psi Units

These four basic casing types can be combined into multiple-unit installations to meet any pressure and capacity requirement. And every design features . . .

GREATER ADAPTABILITY to meet your specific needs. Seals, cooling methods and side-load connections are just a few of the many design details that can be "tailored" to each installation. What's more, every compressor is backed by . . .

MORE THOROUGH TESTING in the world's largest and best-equipped compressor test facility. Here new centrifugal designs, components, accessories and complete machines can be tested, frequently at full load and under simulated operating conditions.

5 MILLION HORSEPOWER of I-R centrifugal compressors are serving all types of applications throughout industry.

263A12

Ingersoll-Rand
11 Broadway, New York 4, N. Y.

annual meeting, Roosevelt Hotel, New Orleans.

10-21 University of Michigan, summer course on underground storage of natural gas, Ann Arbor, Mich.

23-28 National Congress of Petroleum Retailers, annual session, Cosmopolitan Hotel, Denver.

26-28 American Petroleum Institute, Division of Production, eastern district meeting, The Greenbrier, White Sulphur Springs, W. Va.

27-29 Rocky Mountain Mineral Law Foundation, seventh annual institute, University of New Mexico, Albuquerque.

AUGUST

2-4 Wyoming Geological Association, sixteenth annual field conference, Green River, Wind River, and Powder River basins.

20-24 Asphalt Institute, international conference on structural design of asphalt pavements, University of Michigan, Ann Arbor.

28-30 Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

28-Sept. 1 American Society of Mechanical Engineers, international heat transfer conference, Boulder, Colo.

SEPTEMBER

5-8 American Chemical Society, Chicago section, eleventh national chemical exposition, International Amphitheatre, Chicago.

7-8 Rocky Mountain Association of Geologists, field conference, Salida, Monarch, Ouray, Silverton, and Durango, Colo., areas.

7-9 Magic Plains Oil Exposition, Borger, Tex.

11-15 Instrument Society of America, fall instrument - automation conference and exhibit and sixteenth annual meeting, Biltmore Hotel and Memorial Sports Arena, Los Angeles.

12-13 American Gas Association, Southern Gas Association, annual accident prevention conference, Statler Hilton Hotel, Dallas.

13-15 Pacific Coast Gas Association, convention and annual meeting, Coronado Hotel, Coronado, Calif.

13-15 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual meeting, Roosevelt Hotel, New Orleans.

13-15 National Petroleum Association, annual meeting, Traymore Hotel, Atlantic City, N. J.

14 Natural Gasoline Association of America, Rocky Mountain regional meeting, Northern Hotel, Billings, Mont.

15-16 Kansas Geological Society, annual field conference, Mark Twain Hotel, Hannibal, Mo.

17-20 American Institute of Electrical Engineers, annual electrical conference of the petroleum industry, Jung Hotel, New Orleans.

18-19 Independent Natural Gas Association of America, annual meeting, Shamrock Hilton Hotel, Houston.

20-21 American Institute of Electrical Engineers, Institute of Radio Engineers, Instrument Society of America, industrial electronics symposium, Bradford Hotel, Boston.

20-21 Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

24-27 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Muehlebach Hotel, Kansas City.

25-27 Texas Mid-Continent Oil and Gas Association, annual meeting, Texas Hotel, Fort Worth.

OCTOBER

1-4 American Gas Association, annual convention, Dallas.

3-4 University of Kansas, ninth annual gas measurement institute, National Guard Armory, Liberal, Kans.

4-6 American Association of Oilwell Drilling Contractors, annual meeting, Rice Hotel, Houston.

4-6 American Society of Mechanical Engineers, process-industries conference, Shamrock-Hilton Hotel, Houston.

8-11 Society of Petroleum Engineers of AIME, annual fall meeting, Memorial Auditorium, Dallas.

11-12 Western Petroleum Refiners Association, waste disposal and stream pollution conference, Hotel Lassen, Wichita.

12-13 California Natural Gasoline Association, annual fall meeting, Lafayette Hotel, Long Beach, Calif.

15-17 National Association of Oil Equipment Jobbers, annual convention and trade show, Mayflower Hotel, Washington.

15-18 American Petroleum Credit Association, annual conference, Shamrock-Hilton Hotel, Houston.

17-19 American Society of Mechanical Engineers, American Society of Lubricating Engineers, lubrication conference, Morrison Hotel, Chicago.

18-20 Rocky Mountain Oil and Gas Association, annual convention, Denver-Hilton Hotel, Denver.

18-21 American Association of Petroleum Geologists, Mid-Continent regional meeting, Amarillo, Tex.

24-25 Pennsylvania Grade Crude Oil Association and Pennsylvania State University Mineral Industries Experiment Station, technical conference on oil recovery by solvents, Pennsylvania State University campus, University Park.

25-26 Western Petroleum Refiners Association, annual question and answer session on refining technology, Rufus Garrett Hotel, El Dorado, Ark.

25-27 Gulf Coast Association of Geological Societies, annual meeting, Granada Hotel, San Antonio, Tex.

27 Natural Gasoline Association of America, southern regional meeting, Carlton Hotel, Tyler, Tex.

29-31 Independent Petroleum Association of America, annual meeting, Shamrock-Hilton Hotel, Houston.

29-Nov. 1 National Lubricating Grease Institute, annual meeting, Rice Hotel, Houston.

NOVEMBER

1-3 Southwest Federation of Geological Societies, annual meeting, El Paso, Tex.

2-3 Society of Petroleum Engineers of AIME, annual California regional meeting, Hacienda Motel, Bakersfield, Calif.

2-4 Geological Society of America, annual meeting, Cincinnati, Ohio.

5-9 Society of Exploration Geophysicists, international meeting, Denver.

6-8 Chemical Institute of Canada, conference of the chemical engineering division, Royal York Hotel, Toronto.

12 OUT OF 15 SPECIFIED BUELL CATALYST RECOVERY SYSTEMS

Of all the fluid cat crackers engineered in the United States since January 1959, 80% have incorporated Buell cyclone systems for catalyst recovery. To meet the most stringent codes for air pollution control Buell precipitators are frequently specified. Refineries large and small have learned from operating experience to count on the dependability and top efficiency of Buell equipment. Buell Engineering Company, Incorporated, Department 61-F, 123 William Street, New York 38, New York. Northern Blower Division, 6405 Barberton Avenue, Cleveland, Ohio. • Electric Precipitators • Cyclones • Bag Collectors • Combination Systems • Classifiers • Fans

buell Norblo®

50 years ago

June 15, 1911

What is claimed to be the largest core-drilling machine in the world is being used by North River Oil & Gas Co. to put its new extension test northeast of the Providence Oil & Gas Co.'s gas field in Fayette County, Alabama. It uses a 125-ft. derrick and can cut a 20-in. hole, and drill faster through any kind of formation than standard tools previously used. Old-time drillers say it isn't practical.

Oil producers in Oklahoma and Kansas were given some encouragement this week by a 2-cent increase in crude-price posting led by Prairie Oil & Gas Co. and met immediately by The TEXAS Co. and Gulf Pipe Line Co. Now price is 48 cents a barrel.

25 years ago

June 11, 1936

Oil-discovery well of Moore field, south of Oklahoma City field, in northern Cleveland County, Oklahoma, comes in with flow of 4,234 bbl. in 3 hours, and estimated 100 M.M.c.f.d. of gas from second Wilcox sand at 7,240 ft. Testing of Sinclair Prairie Oil Co. 1 Franklin as Oklahoma's largest well in several years indicates new major producing area.

Shell Oil Co. opens California's first oil field to be discovered by geophysical exploration. Discovery well in Stevens area of Kern County flows 650 bbl. of 61.3°-gravity oil with 16,540 M.c.f.d. of gas.

The deepest well so far in the North Louisiana-Arkansas district blows in with flow of 25 M.M.c.f. of wet gas from Trinity pay at 8,100-40 ft. on flank of old Cotton Valley field, Webster Parish, Louisiana.

10 years ago

June 14, 1951

Oil companies in the Jersey Standard family have announced a policy of hiring, for a year or two, college professors who may find their services otherwise unneeded because of the drop in enrollments due to the present Korean War. In spite of cracks made about professors in the early New Deal days when they practically took over the government, a little of the professional approach won't hurt business, and the profs shouldn't be any the worse for spending a few months in the mundane commercial world of industry.

Oil men around Great Bend have long referred to themselves as members of the Oil Patch, but this loose designation is now giving way to a more formal and appropriate organization. They have formed the Great Bend Petroleum Club.

JOURNALLY SPEAKING

Pink Air

IF YOU LIVE outside of American Petrofina's marketing territory, we'll fill you in on pink air.

In full-page newspaper ads Fina, with tongue in cheek, announced a 5-year crash program to develop pink air for automobile tires in a race with competitors who are already "adding additives to additives in their effort to win motorists' favor."

"The reason we're in such a rush," explains Fina, "is that if you want to stay on top you've got to have a little something new from time to time.

"But Fina's gas, oil, and accessories are already just exactly as good as the best. We wouldn't want to add more things to them just so we could say we did. (Oh, we've got additives, all right; we just can't think of any good new names for them.)"

After more of such sarcastic jibes at gasoline advertising, comes the soft sell:

"In the meantime, when you see a Fina station, and if it's on your side so you don't have to make a U-turn and there aren't six cars waiting and you need gas or something, please stop in."

We asked a number of people what they thought of this ad, and the general consensus was: A silly way to attract attention; very amusing, but will it sell gasoline?

Well, our thought is that it's not any sillier than methods used by some other oil companies to attract attention, and that it will sell about as much gasoline as most gasoline advertisements.

If Fina's point is that the average motorist is satiated and confused by the advertised claims to superiority of various brands of gasoline, then we're inclined to agree.

We're not against additives for gasoline—or for air either, for that matter. Doubtless they're all good and some may be a little bit better than others under certain conditions.

But it's our observation that most motorists have concluded that any established brand of gasoline will run their cars about as well as any other, and therefore they are losing their brand loyalty and becoming price conscious.

If this is, in fact, so, then it may be that many old philosophies of gasoline marketing are due for revision.

For instance, it used to be accepted that gasoline that was well advertised, and that was sold in stations giving motorists a lot of special deluxe services (of which pink air for tires would be the ultimate), was worth about 2 cents a gallon more than other brands.

But if competitive brand advertising has reached the point where it fails to convince motorists that one brand really is worth more than the others, we are prompted to ask, how long can that type of advertising and pricing endure?

We raise the question because in various parts of the country we see both majors and independent marketers battling to preserve this "historic differential" while today's motorists couldn't care less and are enjoying the resultant price wars.

Not being in the gasoline-marketing business, it's easy for us to know all the answers. But we do sense a strong trend among consumers generally to shop for the lowest prices (look at the growth of discount houses) and we wonder how long oil marketing can buck this trend.

Maybe there will always be some place for the Tiffanys of gasoline brands and the Neiman-Marcuses of service stations, but we'll wager a cookie that the guy who sells the most gasoline in the years to come will be the guy who can find ways to get it into an automobile tank at the lowest price—even if that means abandoning a lot of traditional marketing practices, a lot of low-volume station sites, and a lot of notions about what the customers are supposed to want.

—Henry D. Ralph

There's good material and plenty of it in these packing elements. (Note the big holes—big because the packer bores are big and unrestricted.)

TWO BASIC MODELS

Model J (Product 756-J) is long-string set. Model K (Product 756-K) is short-string set. Both come with or without hold-down buttons (double or single grip). The picture shows double-grip Model J.

How to make a dual-string hookup that works

Required: a dual packer that works

NOTHING DEFEATS THE ECONOMICS of a dual completion like a dual packer that leaks. You must have a positive and dependable packoff.

It's fundamental—to make a dual string hookup work, you must have a dual packer that works, one that packs off and holds. That, many operators state plainly, is the reason they are using the new Baker duals.

WHAT MAKES THE PACKOFF SO POSITIVE? The reasons are designed into the simple and rugged 3-element packoff mechanism you see in the pictures.

There's been a lot of favorable comment on this design. It holds so well it doesn't need the non-retractable metallic back-up rings that so often stick to the casing and defeat retrievability. The 3-element concept came out of a tough proving ground. It was adapted from Baker's high-performance retrievable squeeze packers, proved in thousands of high pressure downhole operations.

BUT WHEN YOU'RE MAKING THE HOOKUP, you discover that while a positive packoff is essential, it isn't everything. You must have flexibility, too.

When you want to space out, to test packers before displacement—that's when you discover the importance of a packer that offers repeat setting.

A BAKER SNAP-SET DUAL is one packer that gives you both pressure holding power and flexibility. You set and pack off by setting down minimum weight—and the packer holds. You release by picking up.

It's just that simple. You don't pressure, you don't rotate, you don't drop balls—and you don't come out of the hole to re-cock.

You set and unset as many times as you need to. And when your hookup is made, you've got one that works.

BAKER
SNAP-SET DUAL PACKERS

BAKER OIL TOOLS, INC.

HOUSTON LOS ANGELES NEW YORK

49 PAGES OF FACTS

With big pictures and few words, a new brochure tells the interesting engineering facts about Baker's new Snap-Set Dual Packers. Get it from Baker representatives, or write to Baker Oil Tools, Inc., P.O. Box 2274, Terminal Annex, Los Angeles 54, California.

Let's get to the heart of the gas mess right now

THE REFUSAL to face the facts of the natural-gas industry and its regulation is amazing and disgraceful.

That charge applies alike to Congress, the administration, state utility commissions, and all segments of the gas industry.

A condition of chaos, admitted by all for years, is deteriorating to the point of crisis, yet nobody is pushing any solution that even purports to get to the heart of the problem.

IF THERE EVER WAS a good time to get the whole subject out in the open for public discussion it is right now, for congressional committees are beginning study of a number of measures—some originating with the administration, some elsewhere—to modify various aspects of FPC procedure.

But all these bills are simply palliatives. They would treat symptoms, not the underlying cause. They only nibble at the fringes of the problem, and some would even make it worse.

Nobody, in Government or industry, is publicly facing up to the basic issues of producer regulation. All concerned have pussyfooted around it, clinging to old philosophies and animosities, saving political face, and wishfully hoping for a solution to appear from the blue.

But while the stalemated antagonists have their eyes on the past, conditions in the gas industry have changed radically, and its future stability and growth become more uncertain by the week.

It should be clear that the gas industry today is far different from that of 10 or 15 years ago when rising field prices first invited federal attention. Regulatory theories that might have seemed appropriate then are demonstrably unsuited to the problems of today and tomorrow.

Much has been learned about the economics of natural gas in the interim—or could have been learned had not eyes and ears been closed. Any impartial observer should admit that the attempt to regulate individual producers as public utilities has broken down hopelessly.

So the question is what sort of producer regulation will work—if, in fact, any at all is really needed in the public interest today.

THE INDUSTRY HAS PINNED its hopes on a "harmony task force" representing producers, pipelines, and distributors, which has been working secretly for some 2 years trying to get agreement among these three warring segments of the gas business.

This was fine so long as the subject was taboo for public discussion. But the time is past for it to stay underground. Congress seems in a mood to do something, and it should have the whole picture before it.

The time is ripe for open, objective analysis of the gas-regulation mess. Much public education must precede any new legislation, and the sooner this starts the better. All concerned should open their eyes for a new look at the changed economic and political conditions affecting gas.

for CANADIAN OIL FACTS call on CANADA'S FIRST BANK

A $3 billion organization with 285 branches covering the oil provinces alone, Canada's First Bank is uniquely equipped to assist your Canadian oil or gas operation.

"A Guide for Oil & Gas Operators in Canada", 40-page handbook published by the B of M, is yours for the asking. Address John A. Baines, Mgr., Oil & Gas Dept., 140 Eighth Ave. West, Calgary, Alta., Canada —or our nearest U. S. office.

"MY BANK" TO 2 MILLION CANADIANS
B of M
Head Office: Montreal

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Canada's First Bank Coast-to-Coast

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850 BRANCHES IN CANADA, UNITED STATES, GREAT BRITAIN AND EUROPE
RESOURCES EXCEED $3,000,000,000

Major Gas Legislation Appears Certain

• Many groups are joining producers in appeals to Congress for corrective action. Concern is growing that today's "mess" will cut supplies and raise prices. A new Harris bill (next page) may set the stage for a showdown.

Clyde LaMotte
Washington Editor

MAJOR changes in natural-gas regulation now appear almost inevitable.

It is too early to forecast the precise form these changes will take or when Congress will make them. But out of the welter of confusion in Washington there is slowly emerging a realization that something must be done.

The plea for action, once urged primarily by producers, is now being sounded by many other groups—some of which actively opposed or "sat out" previous attempts to get corrective legislation.

Now there is growing awareness that few, if any, are benefiting from the present system and that many, including consumers, are going to suffer increasingly.

There is growing concern that in the long run, unless the system is changed, shorter supplies and higher prices will result.

Important, too, is the fact that in congressional consideration of the problem this year, the blame for the regulatory breakdown is being put on the system itself rather than on any segment of the industry or the Federal Power Commission.

New Atmosphere

All in all, the climate in Washington and elsewhere has changed perceptibly since the last time gas legislation was an issue.

The big remaining hurdle is to get a meeting of minds on the best way to correct the present situation.

The administration, conceding that something has to be done, has proposed that small producers be exempt from direct control.

The FPC, saying flatly that it is impossible to regulate independent producers by utility-type procedures, wants Congress either to give it more time to test the area-pricing approach or to provide the commission with some realistic alternative.

A group of state utility commissioners, also conceding that some new approach must be used, has proposed to reduce the backlog of cases at the FPC chiefly by restricting the number of cases that can be filed (OGJ, June 5, p. 36).

Others, including spokesmen for pipeline associations and pipeline companies, say the current regulatory lag can only have adverse effects on all concerned, and changes must be made promptly.

Producer groups are telling Congress that the cause of breakdown at the FPC should be evident by now—that the breakdown has resulted from the saddling of the commission with the impossible task of regulating producers as if they were a utility.

What most producers want is decontrol, or at least a system of regulation which would recognize the commodity value of natural gas and treat it as such. Such an approach would eliminate strict cost control, particularly in a case-by-case approach, as the principal factor in controlling rates.

Underlying all of these varying suggestions is a sense of urgency for action.

What Congress is facing, therefore, is a choice of avenues.

It appears now that Congress may approach the task of selecting a new course of regulation through a process of elimination.

It is currently considering the proposal of the utility commissioners through hearings on a bill, S. 666, which was drafted by the National Association of Railroad and Utility Commissioners (NARUC).

Most observers consider the current Senate hearings as a preliminary skirmish before Congress really gets down to business on natural-gas regulation.

In other words, there appears little likelihood that S. 666 will be passed, although the Senate committee holding the hearings may approve the basic points of the bill.

S. 666 Attacked

If the elimination process is the course Congress follows, last week's hearings on S. 666 provide some strong grounds for disposing of that approach.

In two days of hearings, opponents of S. 666 had their say. And the gist was that this bill would make things worse instead of better. They said it attacks the symptoms rather than the disease.

Testimony of the state utility commissioners themselves a week earlier had merely added proof to the need for an overhaul of the present system, they said.

"They have made a strong showing of the impossibility of regulating independent producers under an act designed for pipe line companies and not gas producers," Clayton Orn, attorney for Ohio Oil Co., said.

"Unfortunately," he added, "the

New Harris Bill May Trigger Gas Action

REP. Oren Harris (D.-Ark.) introduced a new gas bill late last week which may touch off the showdown battle on gas legislation.

His bill includes some provisions of earlier Harris bills but also includes some administration and Federal Power Commission proposals.

Basically, the new Harris approach would:

... **Flatly prohibit** utility-type regulation of natural-gas producers, thereby ruling out the cost-of-service approach in establishing producer rates.

... **Establish the concept** of treating producer gas as a commodity, and specify that a just and reasonable market price be established.

... **Exempt small producers** from direct regulation. The cut-off point would probably be sale of 2 billion cubic feet annually.

... **Prohibit pipeline** companies (but not producers) from filing successive rate hikes before an initial rate hike is acted on by the FPC. However, FPC would be given authority to make exceptions to prevent an unreasonable hardship.

... **Give FPC** jurisdiction over industrial sales only when commercial and other rates are also involved. Direct sales of gas for resale for industrial use would not otherwise be affected. As it is now, the FPC has no jurisdiction over industrial rates.

Harris said that cost would be included as a factor in FPC consideration of producer rates. However, he said, his bill authorizes the FPC to consider area problems, individual producer conditions, long-range cost and price trends and other economic data.

An important responsibility of the commission, he said, would be to use those factors in assuring a continuing adequate supply of gas for the nation's consumers at reasonable prices.

Harris said he drafted the bill after conferring with administration officials, industry spokesmen from all segments, and with congressmen concerned with regulatory problems.

He said he realized that many people would be dissatisfied with one part or another of the bill, but that he thought it was the best possible compromise approach—and that something obviously must be done soon to end the gas-regulatory breakdown.

He noted that many producers have insisted on outright decontrol, but he said that some regulation of producers simply cannot be avoided.

He hopes, however, that producers will support the bill, chiefly because it clearly states that producers will not be subject to regulation as a public utility.

Aware that pipeline companies will not like the proposed prohibition of successive rate increases, he said that if the new legislation helps FPC catch up on its backlog, then that issue will disappear because pipeline rate requests will be acted on in the specified time, rather than being put into effect subject to refund.

Harris did not indicate when hearings on his bill will be held, but as chairman of the House committee that considers such legislation, he obviously will be in good position to launch such a hearing.

measure which they advocate offers no solution. On the contrary, it would make more difficult the administration of the statute."

Orn appeared as a spokesman for the American Petroleum Institute and for several oil and gas associations.

He attacked the proposals of the state utility commissioners to outlaw escalation clauses, ban filing of successive rate increases, and set a specific time limit in which FPC would be required to settle a case.

On escalation clauses, Orn pointed out their importance in adjusting prices to changing conditions which could not be foreseen at the time a 20-year contract was originally drawn.

He also pointed out what is often overlooked: The FPC already has jurisdiction over any rate hike brought about by an escalation clause. Therefore, the clause in the contract simply gives the producer or the pipe line company an opportunity to try to get a higher rate.

Orn noted, too, that without such contract provisions, producers would be banned from seeking a rate hike without the consent of the purchaser.

Regarding the proposed limitation on filing rate increases, Orn said the effect would be to deny to producers for many years greatly needed price increases.

He pointed out that the impact would be especially heavy on royalty owners and on producers who have dozens of contracts on file with FPC.

Orn's conclusion:

"We think what all of this shows is the necessity of Congress amending, at an early date, the Natural Gas Act so as either to eliminate gas producers from federal price regulations or to simplify these regulations."

W. M. Elmer, president of Texas Gas Transmission Corp., appearing as the spokesman for Independent Natural Gas Association of America, said passage of S. 666 would be a serious blow to the entire industry.

"It makes no attempt whatever to solve the fundamental problems," he said.

He said he was convinced that if the utility-type regulation of producers is continued, costs within 5 years would be much higher than if a commodity-price approach were used.

Dan L. Jones, counsel for the Independent Petroleum Association of America, told the committee that while S. 666 would temporarily protect distributors and consumers from the effects of the "regulatory lag," in the long run even the consumer would be hurt.

The reason, he said, is that the uncertainty and confusion brought about by efforts to regulate producers have tended to slow gas development at the very time that demand has been increasing by leaps and bounds.

What Socal-Kentucky Merger Means

• Consent decree would end Jersey's supply of products to Kentucky and give 40% of this market, within a few years, to independent refiners. For Socal it means 9,000 more stations and five new marketing states.

ADD Standard Oil Co. of California to the list of companies which some day may market in all 50 states.

The company took a big step toward this goal last week when the merger of Socal and Standard Oil Co. (Ky.) was approved in a consent decree cleared by the Justice Department.

The merger puts Socal in five southeastern states — Kentucky, Florida, Georgia, Mississippi, and Alabama—for the first time. These five increase to 35 the number of states in which the company markets.

Only Texaco Inc. markets in all 50 states.

Last week's merger leaves only the Mid-continent area—historically served by Indiana Standard—open to Socal. Having another Standard in a territory won't hamper Socal's expansion plans. The company proved this 15 years ago when it moved its Chevron brand into the East Coast market served by Jersey Standard (OGJ, May 15, p. 104).

The decree . . . The consent decree ended, at least for Standard of Kentucky, an antitrust suit brought against Kentucky (Kyso) and Standard Oil Co., (N. J.) in 1958.

The government claimed that a contract under which Jersey supplied more than 75% of Kyso's product needs was illegal.

Government blessing of the merger of Kyso and Socal removes Kentucky from antitrust charges but leaves Jersey still accused.

The Justice Department entered the consent decree in the U. S. District Court in Louisville.

"We believe (the merger) will stimulate competition," the Justice Department said. "Where we have had one giant (Jersey) selling through Standard of Kentucky, now we will have two competing against each other."

The competition would result, Justice said, because Jersey is expected to set up its own marketing system to compete with Kyso in the five southeastern states.

If Jersey should decline to move into the area, however, the decree would appear to put the government in the position of cancelling out Jersey as Kyso's major supplier and appointing Socal as its replacement — without having stimulated any competition. And Humble Oil & Refining Co., Jersey's operating subsidiary, last week was making no comment on any new marketing plans.

The terms . . . The consent judgment directed Kyso to terminate as quickly as possible its 1956 contract with Jersey under which it agreed to buy 80% of its products from Jersey.

It also provided that after this is done, Kyso must obtain at least 40% of its product needs from independent refiners and no more than 15% from any one.

But this provision won't create any immediate big market for the independents.

The decree says the contract shall be cancelled according to the contract's terms. And these provide a 4-year phasing out period in which Kyso would buy 80% from Jersey in the first year, 60% in the second, 40% in the third, and 20% in the fourth.

The decree suggested, however, that, if Jersey is agreeable, the contract be terminated within 2 years, provided Jersey gives a year's notice that this earlier termination is acceptable.

In any case, the decree says, Kyso may not buy any products from Jersey after July 1, 1966, for sale in any of 11 southern states.

Kyso also was directed not to agree with Jersey on any allocation of sales territories.

What suppliers? . . . The Government was quite specific in deciding who would be able to supply the 40% of Kyso's product needs.

It said an independent refiner is one not among the 21 largest domestic refiners. And these 21 will be determined each year by adding up the domestic capacity of refin-

Here's What Socal Gets in Merger

STANDARD Oil Co. (Ky.) which is to be merged into Standard Oil Co. of Calif. is a marketing company. It has:

- **9,000 retail outlets** in five states—Kentucky, Florida, Georgia, Mississippi and Alabama.
- **A 27% interest** in Plantation Pipe Line, which moves products from Baton Rouge to Greensboro, N. C.
- **Total assets** of $144,574,000.

IN 1960 Kentucky Standard:

- **Sold 34 million barrels** of gasoline, No. 2, diesel and kerosine.
- **Had net sales** of $307,879,439.
- **And net income** of $13,791,937.

ing companies and their "subsidiaries and known affiliates." Capacity figures used will be those published by the Bureau of Mines.

New refinery . . . The decree hinted strongly that Socal is planning a major Gulf Coast refinery.

At one point it referred to the period "after the time Socal's and Kyso's Gulf Coast refinery is in production."

Standard of California officials declined to elaborate on the reference. They indicated, however, that while a refinery is being considered, there has been no decision on size, location, or construction date.

Jersey displeased . . . Jersey Standard officials claimed surprise at the consent decree.

Jersey did not participate in the negotiations, the company said, and, in fact, was not even informed of the merger negotiations. It has not, it emphasized, consented to any part of the judgment.

Particularly surprising, said Jersey, is the fact that Standard of California will be able, before long, to supply 60% of the Kentucky company's needs and, after 20 years, all of its requirements.

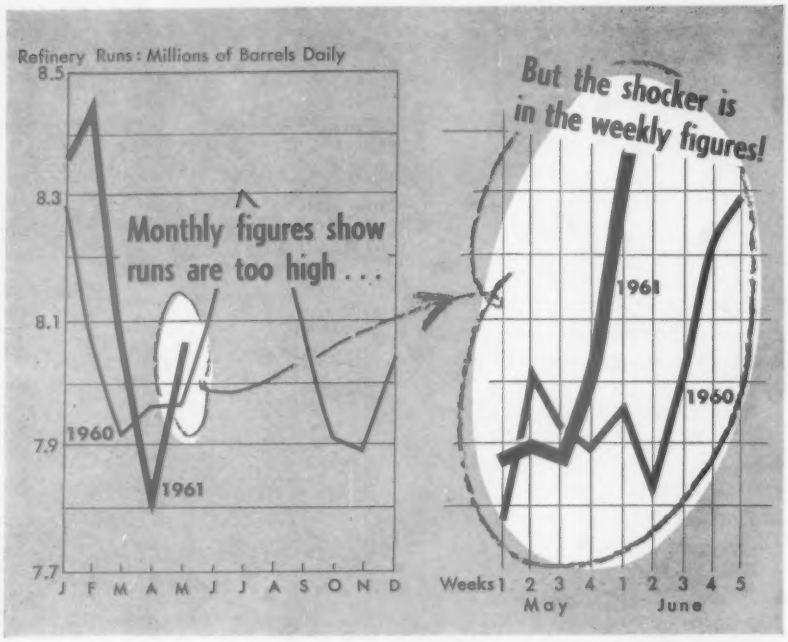
"In contrast," said Jersey, "our contract . . . called for the supply of 80% of the Kentucky company's requirements and was subject to stepwise termination at any time by Kentucky."

Terms of merger . . . Standard of California will acquire the Kentucky company with 2,603,925 shares of cumulative convertible preferred stock being issued to handle the acquisition.

There is no par value for the stock, but it will be callable after 5 years at $80 a share. It carries an annual dividend of $3.30 a share.

The stock will be swapped 1 for 1 for Kyso common and will be convertible into Socal common at the rate of 1 share of preferred for 1¼ shares of common.

The merger announcement had an immediate effect on Wall Street. Kyso stock opened Monday at 75¼ and closed at 81, the year's high. Based on the $81 figure and the number of preferred shares to be traded, the deal amounts to a $210-million transaction.



Runs Soar While Demand Lags

- Latest week shows runs of 8,360,000 bbl. daily—high enough to meet a mid-winter shortage and higher than any monthly average during 1960.

A FEW weeks ago it looked as if refiners were determined to correct their oversupply situation.

After running too much crude in the first quarter, they cut back sharply in April.

When May arrived, they kicked runs up some, but for 3 weeks they held to a reasonable level.

The last week in May, though, runs jumped to 8,050,000 bbl. a day. And the following week refiners discarded all restraints and poured still another 300,000 bbl. daily into their stills.

The figure for the first week ending in June—8,360,000 bbl. daily—is more than 400,000 bbl. daily higher than the same week a year ago. It's as high as January's average, when demand was running above 11,000,000 bbl. daily. And it's higher than any monthly average for the entire year 1960.

Demand off . . . The May-June refinery operations are made more unbearable by poor demand.

During the first quarter demand for all products was down 215,000 bbl. daily at a time when runs for the period were gaining an average of 214,000 bbl. daily.

This higher runs lower demand trend early in the year made it almost imperative that refiners make larger than normal cuts in runs during the second quarter.

Instead the runs have stayed high and demand is still weak. Average total demand last week was slightly over 8,700,000 bbl. daily, lowest for the year to date.

Proof that runs were too high is shown by product stocks.

The four major products showed an over-all increase of 6,343,000 bbl., almost twice the increase made in June last year.

Outlook . . . If the latest refinery report proves a pattern of refiners' plans for the summer, four-product stocks will exceed 450,000,000 bbl. by early fall.

The desirable level for the end of October, based on refiners' own estimates, is 396,000,000 bbl.

But if they hold to the desirable stock level, refiners will have to hold remaining additions to four-product stocks at 18,000,000 bbl.

Legitimate Oklahoma Floods Given Relief

- **Production will be limited to 20 bbl. a day after July 1, but every request for exemption to the rule so far has been granted. No pile-up of applications has occurred.**

OKLAHOMA water-flood operators apparently will be able to live comfortably under a 20-bbl. per well daily production allowable which becomes effective July 1.

So far only a handful of operators have filed applications for increased allowables under exceptional cases. All the requests have been granted.

Many oil men had predicted a rush to file for extra allowables would create a logjam of cases before the Oklahoma Corporation Commission and swamp the examiners who conduct the hearings. This has not developed.

Files of the Corporation Commission show only 34 applications have been filed, hearings held, and the requests granted. Several others are scheduled for action by the examiners.

State Conservation Director Massena Murray estimates that only about 10% of the state's nearly 900 water floods will need the additional allowable. This means from 80 to 90 applications for exceptions at the most.

Murray says the actual number of exceptions probably will be much less since the average production from a water-flood well in Oklahoma is only 8 bbl. daily.

Why the fuss . . . An allowable for secondary-recovery wells is something new in Oklahoma.

It is part of a new set of field rules which became operative April 1. The secondary-recovery rules, however, were made effective July 1.

The basic 20-bbl. per well daily allowable for water-flood projects was devised as a measure of control over water-flood production. This output from old fields has risen steadily and if left uncontrolled threatened to grab off a big share of the Oklahoma crude market. It would mean that production from prorated wells would have to be cut back. And since prorated wells represent newer production, the ultimate result would be a cutback in drilling and exploration.

The operator who can't live under the 20-bbl. allowable can get relief. He gives notice and presents testimony at a hearing showing current injection and production rates and total amount of fluid injection and production since the project started. Further expert testimony is given on the expected performance of the flood and economic factors which make a larger allowable necessary.

The new rules require that for any project to qualify as a water flood:

. . . Current water-injection rate must equal or exceed the current rate of oil and water production.

. . . Cumulative water injected must exceed cumulative oil and water produced since the project started.

In no case will the water-flood oil allowable be permitted to exceed the volume of water injected.

Who's filed . . . Gulf so far has filed the most applications for exceptions, and Phillips has filed on the largest project.

Corporation Commission files show Gulf applications cover eight projects, currently producing 3,704 bbl. daily of oil from an estimated 127 wells. As a result of the hearings, Gulf was granted a maximum allowable on the projects of 5,085 bbl. daily.

The largest single project given additional allowable was Phillips' South Burbank unit in Osage County which currently is producing 24,100 bbl. daily from 640 wells. Phillips' testimony set forth that the project is expected to reach a production peak of 27,000 bbl. daily and asked—and got—this ceiling on its allowable. That's an average of about 42 bbl. daily per well.

Sunray Mid-Continent has filed applications for extra allowable on five projects, Fair Oil Co. on four, Phillips and Texaco on three, Blackwell Oil & Gas and Sinclair on two; and single projects from Ohio, Atmar, C. W. Oliphant, Texfel Petroleum, Vaughan Producing, and Texola Drilling.

Complaints . . . There have been some complaints at the approach taken by the commission in the rules covering extra allowables.

Some water-flood operators say they are put to considerable expense for engineering and legal work to prove they need the larger allowable to prevent waste and protect correlative rights.

They say the approach is wrong if the intention is to weed out the bogus water-flood operators who often have no injection well at all or may have dummy producing wells. The legitimate operator should not have to prove his innocence. The bogus operator should be ferreted out some other way.

The operators also say the request for additional allowable could be handled routinely by administration on written application without a hearing requiring expert testimony and legal counsel.

Oklahoma conservation officials explain the 20-bbl. per well allowable is a yardstick to guide engineers on future project planning. This is based on the contention that water floods can be produced safely at the 20-bbl.-daily per well figure if planned for that amount from the beginning. The exceptional allowables will take care of present projects engineered for higher production and for any in the future where unusual economics prevail.

The conservation officials also say that the commission thus far has granted every request for higher allowables and it's almost a routine matter.

Other controls . . . The commission is taking two other steps which will control secondary-recovery operations.

Operators of all existing projects were required to file by June 1 an affidavit of developed acreage within each project. The commission on July 1 is expected to place the undeveloped acreage on the allocated or unallocated allowable list and assign allowables accordingly.

Operators also were required to file an affidavit classifying their projects as pressure maintenance or secondary recovery. This is part of an over-all commission project to classify every well in the state.

Compact looks for an answer:

Are Prorating States Losing Out in Crude

THE Interstate Oil Compact Commission is making another stab at finding out whether some states are getting more than their share of the crude market.

At the compact's midyear meeting in Houston, 400 delegates gave much of their attention to the touchy issue of whether states that prorate to market demand are being penalized by those that don't.

In the past, efforts to bring the issue to a head have produced only embarrassment and failure. The latest move is designed to avoid both.

This new approach is being made through a five-member subcommittee of the compact's committee on regulatory practices.

To make certain that the nonprorating states would cooperate, two of the five members were selected from Colorado and Utah—and the chairman, Harvey Houston of Denver, is a Colorado representative.

The other states represented are Texas, Oklahoma, and Alabama.

What it does . . . The subcommittee's first job is fact finding.

As one member put it, "We want to find out first whether there's a problem here. Maybe after we get all the information, we'll find that the states are pretty well dividing up the markets fairly."

Factual information will be gathered on the top 20 producing states in Districts 1-4 (omitting the West Coast). The information will consist of state-by-state statistics for the past 10 years on the following:

Daily rate of production, average number of producing wells and producing acres, proven reserves, current number of producing wells and their capacity, current number of leased acres, current proration, state tax revenue from petroleum, and number of persons employed in the oil industry.

The subcommittee will meet in Oklahoma City late this summer or early this fall to prepare a progress report.

John Davenport, the Texas member on the committee and a leader in the Texas Independent Producers and Royalty Owners Association, called for the study but couched his proposal in careful terms.

"We need basic statistics to determine if there are any inequities in the national markets," he said.

Chairman Houston, whose state is often a target for attack, went along with the plan but made some pointed comments.

"This is a very delicate problem. No one is suggesting that anyone could dictate to a sovereign state," Houston said. However, he added, "if there are inequities," and it is clearly demonstrated that culprits exist, "they (the culprits) would recognize that fact and voluntarily employ" corrective measures against such inequities.

The subcommittee agreed further that the study must be directly related to conservation and the prevention of physical waste.

The attack . . . From the outset of the compact meeting, it was apparent that the proration issue was simmering.

Texas Gov. Price Daniel, chairman of the compact, said in his welcoming address:

"I would not be fair to my own state or to those of you from states which are not prorating production to market demand if I did not say to you that the market - demand states cannot forever bear the brunt of curtailed production without your help. . . .

"Those which have not restricted production should realize that without this restrictive action on the part of leading oil-producing states, your own oil industry would be ruined . . . we are following the only policy which can save the domestic oil industry from destruction, but the prorating - market - demand states must have help and cooperation from the other oil-producing states, and we must have it soon."

A TIPRO spokesman sounded off on the same subject. John G. Hurd, immediate past president of TIPRO, told the general session that the threat of federal control hangs over the oil industry as long as equitable market sharing is not achieved voluntarily.

Hurd laid the principal blame for the condition on the leading interstate purchasers, rather than on the state regulatory agencies.

The purchasers, he said, are "not keeping faith with the states which are practicing strict adherence to market-demand proration."

Hurd then quoted from another TIPRO member, R. L. Foree of Dallas, who said recently that "there are really only three states which prorate to demand—Texas, Oklahoma, and Kansas."

This remark brought a rebuttal from Louisiana's former Gov. Sam Jones, a representative to the compact. Jones cited Louisiana's 21-year - old market - demand law and said the state has reduced its production allowable 23 times in the past 8 years.

Attack Opened

TWO NEW natural-gas regulations proposed by the Federal Power Commission will soon come under heavy fire from member states of the Interstate Oil Compact Commission.

The rules would outlaw certain contract - quantity and take-or-pay clauses in natural-gas contracts and would set standards of pipeline quality for gas (OGJ, May 29, p. 115).

The compact unanimously approved resolutions urging its 34 members to make their views known to the FPC before the June 22 deadline set by the federal agency.

Opposition to the proposed rules was sparked by Corporation Commission Chairman Richard C. Byrd of Kansas at the midyear meeting of the compact in Houston.

Byrd said regulation of pipeline quality of gas would cost natural-gas producers in the Kansas section of the Hugoton gas field an average of 4 cents per 1,000 cu. ft.

The regulation is unfair, Byrd contended, because current payments for the gas already take into

Market?

The increases in Louisiana's total production, Jones said, are the result of tremendous increases in reserves—particularly in the Gulf of Mexico, where the federal Government is a huge factor.

His concluding remark: "Texas has held the umbrella over the oil industry, but we in Louisiana have been manning the seawalls."

Other views . . . Although Texas spokesmen carried the attack, those from the nonprorating states expect to have some ready answers when the showdown comes.

For example, Chairman C. R. Henderson of the Utah Oil and Gas Conservation Commission—a member of the subcommittee studying the crude market issue—is set to argue about scope. He says the study will be incomplete unless it shows how certain states, such as his, limit production by a Maximum Efficient Rate Formula and, eventually, what it costs to drill and operate wells.

Such issues as well-spacing and the law of capture—a sore point in Texas—may also come before the subcommittee eventually in its search for information that will help resolve the whole question.

Whatever the subcommittee does, it will be a long time doing it.

A special committee appointed earlier by the compact bogged down. The new group, operating under a standing committee, was authorized at the December 1960 meeting in Phoenix and its members were appointed by Daniel in March.

Standard Forms Making Slow Progress

A 4-YEAR-OLD project to standardize oil-company drilling and production reports by the member states of the Interstate Oil Compact Commission and by the federal Government has moved another step forward.

The U. S. Geological Survey has tentatively accepted revised versions of the well-completion report and the application to drill. Both were prepared by a subcommittee of the compact's committee on regulatory practices.

Subcommittee Chairman O. P. Nicola, Bartlesville, Okla., reported at the compact meeting in Houston that Oklahoma has adopted four report forms and has others whose merits are undergoing tests.

The effort to standardize the forms has made little progress since five states—Arkansas, Mississippi, Alabama, Arizona, and Alaska—adopted them about 2 years ago. Several Rocky Mountain states have withheld action pending a decision by the USGS to adopt the forms.

Nicola says the subcommittee has had no success so far with the two largest producing states, Texas and Louisiana.

The purpose of standardizing some 33 forms is to reduce time and expense of paper work by oil companies, and to simplify reporting to governmental agencies (OGJ, Mar. 10, 1958, p. 84).

on FPC's Latest Gas-Regulation Proposals

account the adverse qualities of the gas for the field as a whole.

In the cases of specific wells, the regulation would cut prices for gas that failed to meet specifications but would not raise prices for those which are above specifications.

The compact's resolution attacking the proposed rule says the conditions imposed on producers are "inconsistent with sound conservation principles and could, in certain instances, cause physical waste of natural gas" and "would not improve the quality of gas delivered to the ultimate consumer."

The rule—Docket R-200—sets forth seven specifications of pipeline quality gas. These cover such characteristics as B.t.u. value, sulfur and hydrogen - sulfide content, and pressure at delivery point. The rule also fixes the rate of price reduction for failure to meet the requirements.

The other proposed rule, involving take-or-pay contracts (Docket R-199), angered the compact members principally because they believe it injects federal regulation into an area traditionally reserved to the states—the conservation and production of gas.

Commissioner Byrd said he had personally advocated voiding such contracts in Kansas when they interfered with proration but that he strongly opposes the FPC's stepping in to do the job.

"These take-or-pay contracts deal with rates of depletion, a conservation matter," Byrd said. "If they (the FPC) can take over that, they could come to Texas and void the allowable orders on the same grounds."

The proposed rule provides that contracts shall be void if they allow a daily-contract-quantity in excess of 1,000 cu. ft. of gas for each 8,000 M.c.f. of dedicated original reserves, and a take-or-pay provision exceeding 80% of such daily - contract quantity on an annual basis.

Walter B. Jones, oil and gas supervisor for Alabama, labeled the proposed new rules as further evidence of "socialism and government control" and called on other compact members to "stand up and be counted" against the encroachment.

Other issues . . . The compact's special committee dealing with area gas pricing and the proposed fuels-policy study reported its findings to the Houston meeting.

While approving the principle of area pricing as a means of eliminating delay in marketing natural gas, the committee said it found no reason for a differential in price between old and new gas contracts. Also it feared that differentials between areas would hamper development in low-priced areas and thus impede the conservation effort.

"To leave these resources undiscovered and undeveloped is waste," the committee said.

The committee recommended that the compact and the member states give full cooperation to any fuels-policy study ordered by Congress, but urged strong opposition to a policy that would seek end-use controls of natural gas.

Appalachian Area Tries Tertiary Recovery

• Penn Grade producers hope thermal-recovery and alcohol flood will extend the life of some of nation's oldest fields. Two tests have been started.

TWO tertiary-recovery projects in Pennsylvania are being watched closely by oil men throughout the Appalachian area and elsewhere.

They are:

... The first thermal-recovery project involving a middle-gravity crude as light as 46° API which will be fired in August in the Goodwill Hill-Grand Valley field of Warren County.

... The world's first alcohol flood on any sizable field scale, begun almost a year ago in Bradford field, McKean County (OGJ, Sept. 26, 1960, p. 104).

Penn Grade production in Pennsylvania, New York, West Virginia, and Ohio has declined to about 32,000 bbl. daily. Average daily production per well is 0.3 bbl. in Pennsylvania and New York and 0.4 bbl. in West Virginia.

These two tests represent different approaches to recovering a larger percentage of oil from the hundreds of millions of barrels still in the ground in the Penn Grade crude region.

They are symbols of the great hope for maintaining production and for saving many fields which have been producing almost 100 years and are now in the twilight of their commercial life.

The experiments are part of a concerted effort to boost recovery throughout the Penn Grade area by operators, by the Bureau of Mines Petroleum Research Laboratory, Morgantown, W. Va., and by Pennsylvania State University.

Fire flood . . . The in-situ combustion experiment is located on Quaker State Oil Refining Corp. property about 10 miles north and east of Titusville, site of the industry's birth in 1859.

The ignition well, drilled to the Venango First sand where combustion will occur, is surrounded by four producing wells. Two are 122 ft. away and the other two are 165 ft. from the ignition well on an irregular five-spot.

Air and gas will be injected into the formation to 400 ft., where ignition will be attempted. At first fuel oil and petroleum coke were thought to be the best ignition materials, but the operators switched to natural gas.

Within a month or two after first ignition attempts this August, operators will know the answer to one important question: Will the producing formation itself sustain a propagating heat wave?

It will require about 9 months to sweep out the tight sand, engineers estimate, if combustion is maintained in the tight sand. Then the verdict will be in on this significant experiment.

If middle-gravity crude can be recovered economically through in-situ combustion, new life will be instilled in this field and probably in other old fields.

Thermal recovery is particularly attractive economically in the Penn Grade areas, where air-and-natural-gas injection has been practiced for years. The compressor equipment and injection wells are already in place, and little capital outlay is needed.

Such was the case with this field, discovered in 1885. So far about 57% of its production has been by air-and-gas injection.

Alcohol flood . . . About two-thirds of a planned volume of 27,000 bbl. of isopropyl alcohol has been injected into the Bradford field near Custer City.

The remainder should be in the formation by September. Then water injection will be resumed.

Some time next spring or summer, the sponsoring oil companies—headed by South Penn Oil Co.—will know whether alcohol flooding has a future in this area.

Other companies supporting the project are Quaker State, Kendall Refining Co., Wolf's Head Refinery, and Bradford Oil Co.

There are four alcohol injection wells in a square with a single producing well in the center. Outside the five-spot are eight other producing wells which will be affected.

Alcohol is being injected at the rate of 100 bbl. daily at 1,100 psi. into the Bradford Third sand at 1,400 ft.

The slug of alcohol acts as a miscible piston.

After injection has been completed, water flooding will be resumed.

There is a possibility of raising per-well production from ½ bbl. daily to between 5 and 8 bbl. daily, the peak under water flooding. Laboratory tests have indicated theoretical recovery of 75 to 100% of oil in place.

Bradford was discovered in 1871 and reached peak primary production 10 years later. Water flooding has been practiced extensively for more than 50 years.

Water flooding reached large-scale proportions by the early 1900's. Field production climbed steadily from 1906 under the stimulus.

But now this, too is becoming uneconomical.

Even if alcohol flooding works here, it wouldn't mean that all fields in the area would respond favorably. But the prospects are attractive enough—and the stakes large enough—to warrant consider-

INDUSTRY

Bids on only 3 of 14 tracts up for lease were made to the Navajo Tribal Council. Aztec Oil & Gas offered a bonus payment of $168,000 for a 160-acre tract in the Aneth area. Three other bids were made for this acreage. W. A. Moncrief, Fort Worth, offered identical bonuses of $8,241 on two other tracts.

New LPG terminal planned by Phillips at West Memphis, Ark., will be the first to be supplied exclusively by jumbo railroad tank cars. Warden Gas, Inc., will operate the 150,000-gal. terminal, which is expected to begin operations by September 1.

Arctic Islands exploration will be started next month by Canadian Homestead Oils. An exploration

able outlay for a project in the Appalachians.

More than $270,000 is being spent on the alcohol alone. The impure grade of isopropyl alcohol being used costs about $10.50 per barrel.

Humble's Use of Enco in New Mexico Challenged by Econ

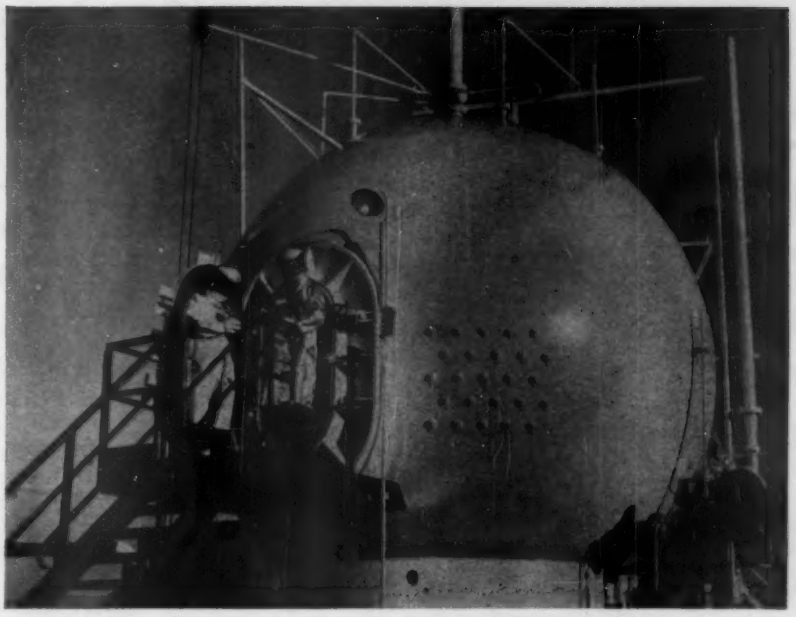
THE new Enco brand name of Humble Oil & Refining Co. has gone to court.

Aware that Econ Gasoline Corp. was objecting to Enco, Humble first filed an application in federal district court at Amarillo, Tex., for a declaratory judgment stating that there would be no public confusion between the two trade names.

Econ Gasoline replied with its own lawsuit at Lovington, N. M., where it asked the state district court to grant an injunction forcing Humble to abandon Enco in New Mexico.

Econ Gasoline is a subsidiary of Famariss Oil & Refining Co. and has registered its brand name both federally and in 12 western states.

Humble attorneys are making the point that the word "Econ" is short for "economy" and that "Enco" is a combination of the words "energy company."



Sphere Used in Rocket Tests

AN 18-foot sphere that simulates space conditions is one of the new facilities for testing rocket fuels at an Esso Research & Engineering Co. laboratory in Linden, N. J.

Other facilities include five test cells in which new propellants can be prepared and fired by remote control.

The sphere contains a rocket engine which is loaded by a mobile robot under the eye of a television camera.

During actual firing, the sphere's door is sealed and all activity inside is controlled from a laboratory room 200 ft. away.

Esso Research is carrying out studies on development of powerful solid rocket fuels under the auspices of the Defense Department's Advanced Research Projects Agency.

BRIEFS . . .

party will concentrate on the southern half of Banks Island and western sections of Victoria Island. W. B. Gallup, Calgary consultant, will head the party.

Exchange of debentures of North Star Oil, Ltd., for those of Shell Oil of Canada will be proposed to North Star debenture holders July 5 in a Toronto meeting. North Star is a subsidiary of Shell, purchased last year. The Shell debentures would carry a slightly higher interest rate.

An eight-barge, double-width tow will be built by Humble for use between its Baton Rouge refinery and river ports in Pennsylvania and West Virginia. The tow, 1,040 ft. long and 105 ft. wide, will have capacity of 200,000 bbl. of refined products. Todd Shipyards, Houston, holds the barge contract and Nashville Bridge Co., Nashville, has the towboat contract.

A chain of 23 service stations in Central California has been purchased by Humble. Purchase pushes Humble's marketing north from southern California where the company has 42 outlets. Of the 42 southern California stations, 38 are flying the Enco banner. The company has no immediate plans to switch the new stations to Enco. City Oil, Inc., Salinas, Calif., sold the outlets to Humble.

An electronic terrain model of northwestern Pennsylvania has been presented to the Drake Well Memorial Park in Titusville by Oil Centennial, Inc., the group which ran the industry's 100th birthday celebration in 1959.

Merger of Dakamont Exploration of Denver into Permian Corp. of Midland has been approved by stockholders of the firms. Both are crude marketers in the Mid-Continent area.

Opening of Arizona's Kaibab National Forest to oil and gas exploration has another adherent—the Arizona Oil and Gas Conservation Commission. The commission went on record in favor of the opening at its last meeting. Lease applications for 400,000 acres in the Kaibab have already been filed and are awaiting action by the Bureau of Land Management and the Forest Service.

Fight Over Patent Rights Under Way

• Problem of how patents are affected when Government makes research contract with private industry creates thorny complications. Legislation to allow federal agencies to call the shots is being considered.

A QUIET but increasing struggle is going on in Washington over government vs. private industry patent rights.

The problem stems from processes and products developed by a company while it has a research contract with the Government. The question is where to draw the line on what patent rights should remain with the Government and for how long, what patents should be made available to anyone, and which should be granted to the company involved in the research.

For instance, suppose the Defense Department contracts with an oil company to develop an improved jet fuel. It is likely that company researchers have been working on that very thing—one big reason why the Government would turn to that firm in the first place.

Suppose, then, that while under the contract, the company does come up with a vastly improved product. Should it get patent rights to commercial use of the new process?

The Defense Department thinks so. All it insists on is that the Government shall have free license to use the process. It could, if it wanted, turn the process over to another company to use in providing jet fuel for the military. But the original company would have the patent rights in commercial sales.

Under proposed legislation being considered by a Senate subcommittee, however, the Government would have all rights to such a patent. However, it would be permitted to waive those rights under certain conditions. Several governmental agencies favor this move.

Advocates of such legislation, headed by Sen. Russell Long (D.-La.), say that since the Government foots the bill for research and development contracts, it should reap the advantages—not the company doing the work under a cost-plus fixed-fee contract.

What Patent Legislation Would Do

BRIEFLY, proposed legislation affecting patent rights would:

- Make a patent applicant prove he received no government aid, cash or otherwise, in devising a process or invention.
- Give the federal Government complete ownership of commercial applications springing from government-financed-or-aided research.
- Allow a new civilian agency authority to grant foreign governments access to critical defense-patent information.
- Allow the Government to collect royalties up to 50% on patents until federal investment is recovered.
- Cut the terms of all patents, and make holders prove they have reduced a patent to practice (offered it for sale) in order to receive an extension.
- Add compulsory licensing to all patents, making the holders prove right to exclusive use.

Long says, too, that unless action is taken, a few big companies will wind up with most of the new patents and that this will tend to build monopolies—aided by public funds.

Defense stand . . . The Defense Department, in rebuttal, told a Senate subcommittee that the proposed legislation would remove much of the incentive which companies now have to undertake research and development work for the Government.

"The title policy applied across the board would seriously jeopardize our research and development program," a spokesman said, indicating that the Government might have trouble finding any company willing to undertake governmental research and development.

This drew a hint from the Justice Department that companies might be charged with antitrust violations if there is any indication of agreement between them to shun such contracts.

A spokesman for the U. S. Chamber of Commerce, which strongly opposes the legislation, argues that the restrictions on private patent rights would have a deterring effect on development of new processes and products for public use.

This is his line of reasoning:

If a company doing research work for the Government discovers a possible commercial application, it may undertake to develop and market it.

But the company might be reluctant to do so without patent protection because if it proved successful, anyone else could get into the act and benefit from the original company's efforts.

With little or no patent protection in such situations, a potential commercial application might gather dust on a shelf unless the Government itself decided to develop and market it.

This would put the federal Government in the business of exploiting commercial products and processes developed through direct or indirect government assistance.

Small business angle . . . On another point, Sen. Long says one reason he is pushing the legislation is that it would help give small business an equitable share of government procurement.

But the Chamber of Commerce

spokesman insists that patent rights help a small business even more than a big business. Therefore, the proposed changes would work to the detriment of the small company, he maintains.

Most observers feel that the proposed legislation has little chance of passing during the current session, but note that it is being given an increasingly hard push by its advocates.

California Agency Approves the Rock Springs Gas Line

TENNESSEE Gas Transmission Co.'s bid to invade the West Coast gas market received a jolt last week when the California Public Utilities Commission approved a competing proposal backed by El Paso Natural Gas Co.

The PUC gave final approval to the so-called Rock Springs project which calls for gas from El Paso and Colorado Interstate Gas Co. to move into the Los Angeles market. Pacific Lighting Gas Supply Co. will pick up the gas at the California-Nevada border and move it to its distribution subsidiaries.

TGT, through California Gas Transmission Co., is seeking to serve the same market with gas from Texas to Mexico. Humble Oil & Refining Co. would be the major supplier and Southern California Edison Co. the major customer.

PUC is continuing its hearing on the Texas-to-Mexico-to-California line even though it approved the Rock Springs line. Some observers feel last week's decision will delay TGT's move into the West Coast but certainly won't kill the plans.

The Federal Power Commission approved Rock Springs once but has not approved the amended proposal adopted last week by PUC. Under the new proposal, construction of the new line would be delayed from 1962 until 1964 and the price of gas at the California border was cut to 33.38 cents an M.c.f. from 40 cents an M.c.f. during 1962 and 1963.

It appears likely FPC would approve the revised proposal. However, a petition has been filed to reopen the case due to the conditions attached by PUC.

Watching WASHINGTON

Clyde La Motte

• MPSA learns that machines work faster than pencils . . .

THE MILITARY is pleased with its first test of the use of punch cards in getting and processing bids for petroleum supplies for military posts, camps and stations.

In the trial run, in Region 5, awards to bidders are being made 2 weeks ahead of schedule, thereby giving suppliers 30 days' notice before date of delivery instead of the customary 15 days.

Here is the way the new system works:

The prospective suppliers are sent a set of preprinted cards. The bidder only has to fill in the item and the price and send it back to the Military Petroleum Supply Agency before the bid deadline. Heretofore, the bidder had to disassemble a bulky invitation to bid, fill in the bid information, and staple the stuff back together again.

After the bids are received at MPSA, the cards are punched and fed into a machine which sorts them as to item and price and photographs the cards into an evaluation sheet.

All this chore work by the machine saves MPSA officials and staff a lot of time formerly spent manually transcribing bid information to evaluation sheets. And it is no military secret that the employes, being somewhat human, occasionally made errors while doing this pencil work.

Rear Adm. O. P. Lattu, executive director of MPSO, says comments from companies submitting bids in the first test "have been most favorable."

Encouraged by the time and effort saved and by the industry's favorable reaction, MPSA said the system would be "phased in" during the cycle of regional procurement, and that all regions should be using the new mechanical system by late 1962.

The mechanized approach is one of several steps MPSA has tried, or is trying, in an effort to speed bid handling. For the military, it enables the MPSA to take in a wider range of bids and handle them better. For industry, it provides more lead time and as a result tends to increase efficient, orderly supplying of products.

• Interior is considering a new offshore lease sale . . .

ANOTHER federal Louisiana offshore lease sale is now in the embyro stage. If it develops, the sale will probably be in February.

Luther Hoffman, recently promoted to assistant director of Interior's Bureau of Land Management, says that serious consideration is being given to a call for nominations sometime this fall. The response to such a call would determine whether a lease sale would be held.

• O'Connor still in the race for an FPC appointment . . .

CONSIDERABLE behind-the-scenes jockeying is going on as time nears for appointment of a replacement for Arthur Kline on the Federal Power Commission. The term of Kline, a Republican, expires June 22.

Strangely, few names are being bandied about. At this stage it appears that L. J. O'Connor, Jr., the Oil Imports administrator, has the inside track. Meanwhile, the Senate was still marking time last week on approval of the nominations of Joseph Swidler and Howard Morgan to the two spots already open on the commission.

Tube-Goods Competition Sparks Price Cut

• National Tube gives distributors an additional 4% commission on casing, tubing, and drill pipe. Company also cuts price on X-52 line pipe.

U. S. STEEL'S National Tube Division has made two important price changes in oil-industry tubular goods. The changes reflect fierce competition for business, and other companies may follow suit.

Specifically, here is what National Tube did:

... **It reduced** the price of X-52 seamless black line pipe by $18 per ton, or roughly 10%. Affected sizes are 6⅝-in. through 12¾-in. only.

... **It granted** distributors an additional 4% commission on casing, tubing, and drill pipe.

The extra commission will apply only to materials going to stocks, and it will give distributors the option of reducing prices by this amount to meet competition.

The cut in line-pipe prices is of limited importance, and the question is whether it will spread to other types and sizes. The API Grade X-52 is often used for products lines, gas-gathering systems, and city mains but is not used for large-diameter gas trunklines.

The new price, however, makes X-52 sell for less than Grade B pipe under certain conditions. The revised mill prices apply to minimum carload quantities of each diameter and wall thickness ordered from the National Tube mills at Lorain, Ohio, and at McKeesport, Pa.

Why cut occurred ... National Tube said the cut was made to meet competitive conditions in the transmission-pipeline market. There were reports in the industry that some of the smaller pipe manufacturers have been selling at prices comparable to the new National Tube price.

The development in the oil-country pipe pricing was described by a competing company as important because of the way in which it was done.

By granting additional commission to distributors, National Tube in effect was placing the burden of meeting competition on the distributor instead of the manufacturer.

"The situation is generally confused, and we don't really know yet what they are doing," said the official of the competing company. "There has not been a price cut, but apparently they are moving the competition to the distributor. No doubt we will do something to meet any competition that develops."

Both U. S. Steel and other major companies confirmed they have been outbid on recent orders by smaller companies and are being forced to meet the competition.

Aim of commission boost ... One of the obvious purposes for granting an extra 4% commission on casing, tubing, and drill pipe is to encourage distributors to increase their stocks. The higher commission does not apply if the shipment goes directly from the plant to the distributor's customer.

If the distributor cuts his prices by 4%, he will not make any greater profit than before—but one industry spokesman said there is good reason to believe an interim period of cutting would be followed by a firming up of prices again.

National Tube did not elaborate on its reasons for raising the commission rate.

However, one outside observer pointed out that the company would save money by having materials in the warehouses of distributors. This would avoid the need for making quick, and expensive, shipments by rail to fill orders.

Ordinarily oil-country pipe moves by barges to river terminals.

Phillips Plant Strike Turns Critical

A 5-MONTH-OLD strike by 625 workers at Phillips Chemical Co.'s Pasadena, Tex., plant has reached a critical stage.

The plant manager for the Adams terminal, H. D. Trotter, told the Oil, Chemical, and Atomic Workers Union that the company has begun contracting out certain operating and maintenance work.

"We plan to continue, through this and/or other means, to place Adams terminal on a permanent basis insofar as staffing and continued long-range operations are concerned," Trotter said.

Negotiations between the union and the company have broken down completely, although similar strikes at Phillips' plants in Dumas and Borger were settled several weeks ago.

Half a dozen issues separate the two sides, including use of operators and testers for maintenance work in the plant and the combining of jobs.

The company has continued to operate four of the five units in the plant with supervisory and other personnel.

A union spokesman charged Trotter with introducing new company demands into the negotiations after the strike started last January 7. The spokesman said union members will refuse to return to work

PIPELINE

Under a ruling of the Utah Public Service Commission, Uintah County's gas will go to Mountain Fuel Supply. The agency ruled in favor of Mountain Fuel's proposal to build a 103-mile, $10-million line to connect the field to its system in a joint venture with Utah Natural Gas, an El Paso Natural Gas subsidiary. In effect, the ruling denied a Utah Gas Pipelines application to build a line primarily for service to Kennecott Copper.

A converted bulk-carrier will lay 53 miles of parallel 7-in. flexible plastic-steel gas pipeline for Magna Pipeline Co., Ltd., between British Columbia's mainland and Vancouver Island. The 10,350-ton Photinia has been chartered by British

rather than accept the terms "the company is trying to dictate."

Trotter said the company's last proposal—turned down by the union—is realistic, fair, and in the interest of both employes and the company. Any future layoffs, he said, would be determined after the end of the strike.

The plant at Pasadena produces ammonia, polyethylene, and other petrochemicals.

Election Set for NPRA

MERGER of Western Petroleum Refiners Association and the National Petroleum Association apparently will become effective July 1.

Representatives of 95 refining companies will meet June 28 in Chicago to elect officers of the new National Petroleum Refiners Association which will take over the functions of both existing groups.

The merger was approved in principle by directors of WPRA and NPA in April.

The new association will start with 95 member companies and will continue present offices in Tulsa and Washington.

All services to members of both associations will be continued by the combined organization.

The first general meeting of the new NPRA will be held in Atlantic City September 13-15.

New Tool Checks Accuracy of ACT Meters

PIPELINERS for Shell Oil Co. in Los Angeles have developed a tester for meters on pipelines and automatic custody transfer (ACT) units.

The tester is a loop of line pipe mounted on a trailer. Oil is diverted into the loop. The flow pushes a rubber ball which kicks off an electronic counter connected to the meter being tested. The meter reading is checked against the known capacity of the loop to determine the meter's accuracy.

Shell says the loop test is more portable and easier to handle than conventional calibrated tank-meter provers. Units with capacities of 10, 5, and 2½ bbl. are used on the coast.

BRIEFS . . .

Insulated Callender's Cables for the job, which is scheduled for 1963 (OGJ, Jan. 16, p. 62).

Contracts for 86.6 miles of 24-in. and 36-in. line between Beaver, Okla., and Albert Lea, Minn., for 60 miles of 26-in. line east of Ogden, Iowa, and for 64 miles of 26-in. line east of Waterloo, Iowa, have been awarded to R. H. Fulton & Co. by Northern Natural Gas.

A contract to build the 106-mile 12-in. line which Montana Dakota Utility plans between Minot, N. D. and Bismarck has been awarded to Williams Brothers.

The 170-mile 8-in. line from La-Verne, Okla., to Newalla, Okla., which Sinclair Pipe Line will own and operate, will be built by R. H. Fulton & Co. No starting date has been set.

Pipeline common-labor wage rates will go up an average of 10.6 cents per hour in 1961, or 5.2% above 1960 rates. Increases range from a low of 5 cents in some states to a high of 20 cents in others. They apply to all states except Alaska, Hawaii, and Nevada. These three will get determinations later.

Three river crossings in New Jersey will be installed for Texas Eastern Transmission by Missouri Valley Dredging. The rivers are the Millstone, Raritan, and Rahway.

Also for Pipeliners . . .

IN THE NEWS: Climate better in Washington for major change in gas legislation as Oren Harris introduces a new bill (p. 79) . . . Oil compact member states take aim at two new natural-gas regulations proposed by FPC (p. 84) . . . California Public Utilities Commission approves controversial Rock Springs gas line (p. 89) . . . U. S. Steel's National Tube Division cuts price 10% on X-52 line pipe (p. 90) . . . Monitoring system allows one man control of Mid-America Pipe Line (p. 94) . . .

PLUS THIS TECHNICAL REPORT: Twin-arch span offers a new approach to pipeline crossing (p. 151).

Rehearing Sought On Normanna Field Ruling

• New motions will temporarily hold up effective date of Texas Supreme Court order on small-tract drilling. However, observers don't expect reversal.

A LAST-DITCH attempt was under way last week to persuade the Texas Supreme Court to reverse its historic Normanna field decision and its inherent heavy blow to small-tract drilling in Texas.

Attorneys acting for Bright and Schiff, Dallas independent operator, and the Texas Railroad Commission for the second time filed motions with the court for rehearing on the Normanna case.

The new motions came less than a week after the court rejected the first petitions for rehearing May 31.

The effect of this latest action is to delay—temporarily at least—the date when the court ruling becomes final. And this likewise delays the date when the ball gets tossed back to the Railroad Commission.

The Normanna decision remands the case to District Court with orders to issue an injunction prohibiting the commission from enforcing its standard one-third acreage, two-thirds well gas-proration formula in this field (OGJ, Mar. 13, p. 100). It directs the commission to devise a rule "fair and just to all parties without depriving any of them of his property."

The court based its ruling on grounds that the formula adopted would result in "enormous drainage" of gas from regulation-size 320-acre wells in the field to a well drilled on 0.3-acre town lot by Bright & Schiff. This, the court said, is prohibited by seven sections of the Texas conservation laws which require the commission to prorate production equitably between wells in a field.

Other than the "fair and just" yardstick, the court offered no guide to the commission on a new formula. And the commission declined to consider what it might do until litigation was completed.

Reversal chances slim . . . Consensus of legal opinion is that odds are very slim that the court will rehear the case.

Historically, the court has dealt quickly with second petitions such as this and has made short shrift of most. It is expected to rule on this one within 1 to 2 weeks.

There is a possibility, however, that the case might be taken to the U. S. Supreme Court if the Texas court again refuses rehearing.

No grounds had been laid for such an appeal prior to last week. But petitioners were known to be considering laying such grounds in their latest petitions.

If an appeal were taken to the nation's highest court, the Texas gas-proration snarl would be extended until fall at least. The Supreme Court adjourns July 1 until October, and could not possibly deal with the issue prior to adjournment.

This would mean that gas-proration cases probably would continue to pile up on the Railroad Commission's docket. Commission policy has been to withhold action on cases involving field rules in gas pools where there are proration disputes until the Normanna smoke has cleared.

Petitioners pessimistic . . . Contacted by the Journal in Dallas last week, H. R. Bright, partner in Bright and Schiff, was frankly pessimistic over prospects for winning the case.

"Statistically," he said, "it is a long, long, long shot that the Supreme Court will grant our second petition for a rehearing. However, we are hoping that other justices may change position due to the strong dissent by Justices Clyde Smith and Meade Griffin to the court's rejection of our first rehearing petition."

The dissent . . . As is customary, the Texas court did not write an opinion in rejecting the first rehearing petition.

Smith and Griffin definitely did—21 pages worth.

Their opinion criticized the Normanna decision as "practically effecting unitization—though it is well established that there can be no compulsory unitization in Texas."

Furthermore, said the dissenting justices, the ruling:

. . . Is inconsistent because the court in the past has consistently upheld all commission oil and gas orders when supported by "substantial evidence."

. . . Does not make the slightest suggestion as a guide to the Railroad Commission.

Some attorneys have hailed the Supreme Court action as the death knell for small-tract drilling in Texas.

Work Starting on West Shore Pipeline

CONSTRUCTION starts this month on the West Shore pipeline which will move products from Chicago to Green Bay, Wis., via Milwaukee.

The 285-mile 16 and 10-in. products line is expected to be completed in September.

Ten oil companies backed the system with the aim of cutting transportation costs (OGJ, April 10, p. 70). Initial capacity of the line will be about 75,000 bbl. daily.

Contracts have been let to Midwestern Contractors for Section 1, 2 miles of main line and 8 miles of receiving lines.

Contracting & Materials Co. will do the work on Section 2, 32 miles of main line and 4 miles of receiving line, and on Section 3, 32 miles of main line and 1 mile of receiving lines.

The contract for work on Section 4, 61 miles of main line, went to Houston Contracting Co.

Work on Section 5, 36 miles of main line and 7.5 miles of receiving lines, and work on Section 7, 23 miles of main line and 6 miles of delivery lines, will be handled by Somerville Construction Co.

Panama-Williams Corp. will build Section 6, 76 miles of main line.

Station contracts will be let in July.

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DELIVERY at a distribution terminal on Mid-America Pipe Line Co.'s big automatic products line is initiated by company President Robert E. Thomas from a control console in dispatcher's office at Tulsa. David A. Roach, vice president, watches changes on the board.

One-Man Control Devised for Big LPG Line

• Monitoring system allows dispatcher at Mid-America Pipe Line's headquarters to steer operations on 2,184 miles of lines by pushing buttons.

CONTROLS that will act as the "nerves" of the most automatic long-distance products pipeline in the nation are being checked out.

They will put the full length of the mainline and laterals in Mid-America Pipe Line Co.'s 2,184-mile LPG system under a dispatcher in Tulsa.

Every operation—from the receiving of product at the mainline's origin in Hobbs, N. M., to distribution at seven terminals in Nebraska, Iowa, Minnesota, Missouri, and Wisconsin—can be controlled from the Tulsa home office.

The system was designed, assembled, and installed by Union Switch & Signal Co. Union dubbed it Centralized Transport Control—CTC for short.

How CTC operates . . . The system operates over communications channels leased from the Bell telephone network.

One of CTC's two channels is for teletyped information. The other is reserved for supervisory controls.

All 16 stations in the CTC system are linked to the control center by these leased lines.

In addition to sending commands, the Tulsa dispatcher receives information on operating conditions from the stations. Signals on a board show suction, case and discharge pressures at all stations, a station fault, a power failure, a communications failure, and a scrapper arrival. The board also shows what pumping units are operating and whether there is a mechanical or electrical fault.

This kind of information can be obtained from any place in the system whenever the dispatcher needs it. If there is no special need, it is routinely logged on an automatic typewriter every hour.

If a station fault occurs and is corrected, the station can be restarted automatically. If there is a power or communications failure, a maintenance man is required and the local power company or the Bell system is notified.

Mid-America keeps two-man teams at Hobbs, N. M., Liberal, Kans., Sanborn, Iowa, and Moberly, Mo. These men are technical specialists and each is competent in both mechanical and electrical work. Such specialists can be at any point

AUTOMATED operation of Mid-America Pipe Line Co.'s LPG system is helped by this compact digital-computer center. Several functions are performed here, including daily reports on receipts and deliveries.

in the system in an average of about 2 hours.

Since Conway, Kans., and Hobbs are the only attended stations on the system, these teams have 14 stations to watch. If a major fault does occur, the station is by-passed until the fault is corrected.

All information is conveyed by coded signals. A separate signal controls each function.

Stations can transmit information to Tulsa simultaneously. When this occurs, the system automatically transmits the information in order of importance. Controls or delivery-set-point commands from the office rank first, lamp indications from the field next, and then data quantities from the field.

The system also disciplines itself. This is needed to avoid interference between stations, insure orderly handling of information and prevent the loss of information.

CTC disciplines itself by:

... **Spotting** and rejecting codes distorted in transmission;

... **Coordinating** code assignments initiated simultaneously;

... **Automatically** handling code information for orderly transmission;

... **Removing** one station from the line if another has more important information to transmit;

... **Providing** a means of canceling control codes placed in storage.

... **Recalling** invalid indicating codes automatically.

... **Supplying** a method of recalling indication codes on demand.

... **Giving** preference to a control code over an indication code from the field.

Stations are equipped with monitoring devices that automatically detect dangerous conditions, shut down motors, and prevent them from restarting. Sequence equipment is used to start and stop pump units.

Supplementary equipment includes a small digital computer that can handle either punch cards or tape. This compact computer center does several jobs for Mid-America. One is to type individual reports on receipts and deliveries every day.

Honolulu Proxies Mailed

DETAILS of the $361-million sale of Honolulu Oil Corp. to Pan American Petroleum Corp. and Tidewater Oil Co. were revealed last week in a proxy statement sent to Honolulu stockholders.

Pan American is laying out $289,810,267 for 77% of Honolulu's crude and natural-gas-liquids reserves and 68% of gas reserves. Tidewater will pay $71,897,500 for the remainder of the holdings.

Total amount to be distributed to stockholders is about $380 million.

A reserves study made by James A. Leis Engineering, Inc., Dallas, puts Honolulu's proved liquids reserves at 574.7 billion cubic feet.

The report credits 96.5 million barrels of oil to Honolulu properties which are being flooded or proposed for flooding. The engineers point out "it would not be unusual" for an almost equal amount of secondary oil to be recovered from the fields.

Pan American will get all Honolulu properties other than the company's California holdings, and half interest in 104,985 acres of undeveloped leases in Alaska.

Both buyers will handle about 75% of their deals with production payments. Pan American's oil payment totals $215,000,000 and Tidewater's is $55,000.

The production payments will be handled through Chase Manhattan Bank by 10 investment companies (OGJ, May 22, p. 60).

WHAT HONOLULU IS SELLING

(Daily net production, Feb. 1961)

	Crude (B/D)	Natural Gas (M.c.f.d.)
California	10,834	37,138
Texas	17,263	31,995
New Mexico	131	1,375
Montana	3,107	.....
Wyoming	8,179	.....
Alberta	5,633	6,663
TOTAL	45,147	77,171

The companies buying the Pan American production payment are Non-Dak Oil Corp., East Wall Street Corp., Tina Minerals Corp., Broad-Exchange Corp., Continental Consolidated Corp., Long Point Corp., and Narvan Corp.

The four companies buying the Tidewater payment are Long Point Corp., Albantu Oil & Gas Corp., Morlyn Oil Co., and Calprintz Corp.

Top men hired ... Honolulu's three top executives have been hired by the purchasing companies.

L. A. Cranson, Honolulu president, will serve as a consultant to both companies for 10 years and receive $200,000. A. S. Donnelly, an executive vice president, will receive $140,000 as a Pan American consultant for 5 years. W. H. Kraft, another executive vice president, will join Tidewater until December 1963 at an annual salary of $37,500.

The remaining employes who have been with Honolulu 2 years will be offered jobs if their work fits into the operations planned by the buyers. Those not offered jobs will receive severance pay.

The sale is expected to be flanged up at a special Honolulu stockholders meeting July 10 in San Francisco. If the sale is approved by two-thirds of the stockholders, the deal is expected to be closed August 1.

Three liquidating payments are planned.

Interior clears up "misunderstanding" on resid quotas

INTERIOR DEPARTMENT is not planning to shift gradually from a historical basis to a terminal-input basis in establishing residual fuel oil quotas, Assistant Secretary John Kelly said last week.

Kelly said many in the industry apparently have concluded that the reduction by 3 percentage points in historical quotas for the current allocation period will be followed by similar reductions in later periods—so that the historical quota will eventually be eliminated.

As a result, he said, some historical importers are already shaping their marketing practices to fit a terminal-input quota pattern.

To correct the "misunderstanding," Kelly said the regulations are being amended to specify that the reduction will apply only to the period which will begin April 1, 1962.

Appeals Planned in Indiana Price-Fix Case

• Federal judge's ruling that 11 firms conspired to fix gasoline prices in South Bend area will be taken to final battleground: U. S. Supreme Court.

SEVERAL of the 11 oil companies fined by a federal court on Indiana price-fixing charges plan to appeal their convictions.

Standard Oil Co. (Ind.) and 10 other firms were found guilty of gasoline price fixing in the South Bend area. They were fined up to $50,000.

A twelfth company, Gulf Oil, was acquitted by Judge Luther M. Swygert in his ruling handed down at Hammond, Ind.

Swygert denied acquittal motions made by 10 companies.

The Swygert decision upheld a jury verdict of last December 30. The jury found the companies guilty of price fixing in April and May 1957, at the end of a long retail price war.

Swygert assessed these fines:

Indiana Standard, $50,000; Socony Mobil Oil Co., $45,000; Shell Oil Co., $45,000; Texaco Inc., $45,000; Phillips Petroleum Co., $45,000; Cities Service Oil Co., $45,000; Ohio Oil Co., $45,000; Central West Oil Corp., $50,000; Hudson Oil Co. of Illinois, Inc., $30,000; Tornado Oil Co., Inc., $20,000; and Pacer Oil Co., Inc., $5,000.

Among companies planning appeals are Indiana Standard, Texaco, Ohio, and Mobil.

Merwin Bristol, general counsel of Indiana Standard, said his company believes "a fair appraisal of the facts will establish that the long retail price war ended at South Bend in May 1957 because of independent action by competing oil companies, without any agreement or uuderstanding between them."

H. J. Potts, division general manager of Mobil, said:

"We have every reason to think that review of the earlier trial will result in a reversal of the verdict."

Sinclair antitrust case . . . In a separate matter, another oil company has recently appealed an unusual antitrust conviction to the U. S. Supreme Court.

The conviction posed the question of whether an oil company can be found guilty of coercive tie-in sales — a violation of antitrust laws — in the absence of written agreements or when an alleged victim is at liberty to handle competitive items.

Such a finding was made against Sinclair Refining Co. last year by a circuit court of appeals in Baltimore.

The company lost a motion for rehearing, and now has lodged an appeal to the Supreme Court.

According to the Sinclair brief, the general background of the case is this:

In 1956 the company canceled a lease held by S. K. Osborn, Baltimore, on grounds that profits were too low on his sales of gasoline, tires, batteries, and accessories. Sinclair distributed the TBA items under a contract with Goodyear Tire & Rubber Co.

Osborn sued for triple damages. He charged Sinclair conspired with Goodyear to restrict commerce in TBA items, that Sinclair monopolized TBA sales in a market comprised of the company's Maryland service-station dealers, and that Sinclair forced its Maryland outlets to sell Goodyear TBA products under threat of losing their leases.

A federal district judge, in finding for Sinclair, held that Osborn had conceded he hadn't proved a tie-in arrangement which violated the Clayton Antitrust Act.

Osborn appealed to circuit court. This court upheld Sinclair's defense of the restriction and monopoly charges, but it found the company guilty of tie-in.

Sinclair maintained that the court inferred "the existence of tacit understandings between Sinclair and its dealers."

"Even here, however," Sinclair said, "the court conceded there was no agreement, even of an implied nature, that Goodyear TBA would be purchased to the exclusion of competing brands.

"Rather, it was found that Sinclair dealers were given to understand that their dealerships might not be renewed if they did not purchase substantial quantities of Goodyear TBA," the company said.

Sinclair stressed that none of its dealers handled the Goodyear line exclusively.

Mobil Plans Fire Flood in Southern Oklahoma Field

AN INCREASE in oil recovery of 4 to 10 million barrels is expected as a result of fire flooding 450 acres of the Ed Cox field in Carter County, southern Oklahoma.

Mobil Oil Co. is completing plans for the in-situ combustion project to boost output which has been limited by the heavy viscous character of the crude. Gravity is from 15° to 28° API, and viscosity ranges up to 900 centipoises.

The pilot burning project is scheduled to get underway about September 1 in the Mobil Cox Pennsylvanian sand unit. Production is from depths ranging from 900 to 2,000 ft. Mobil operates 59 wells on seven leases.

The unit area produced above

PROCESSING

A natural-gasoline extraction plant, to be jointly owned by Socal and Humble, will be built at Gaviota, Calif., by Black, Sivalls & Bryson. The new plant, with a gas capacity of 30,000 M.c.f.d., will represent an investment of about $500,000 when completed in mid-October.

A new polyethylene resin specifically developed for extrusion coating will be made by Phillips Chemical Co. in new facilities under construction at Houston. The new coating resin can be applied at rates exceeding 600 ft. per minute on standard equipment with consumption of less than 5 lb. per ream.

Crude-oil capacity at Ohio Oil Co.'s Robinson, Ill., refinery has

100,000 bbl. last year, bringing cumulative production to 2,133,000 bbl. Extent of increased recovery will depend on success of the pilot programs.

Crude oil will be fired in place by a natural-gas flame front. The heated crude will then flow more readily to the well bore.

In the first phase of the project, Mobil will drill one well in the field.

A 5-mile pipeline from Mobil's Graham gasoline plant will supply fuel gas. An 880-hp. compressor will be installed to deliver up to 2,800,000 cu. ft. daily of air for the combustion mixture.

If initial results justify expanding the thermal-recovery project, compressor horsepower to deliver 10,000,000 cu. ft. daily of air will be installed.

New Antitrust Weapon Sought

- Sen. Kefauver has administration support for measure giving Government broad subpena power in civil cases.

WITH a helpful push from the administration, Sen. Estes Kefauver (D.-Tenn.) is hopeful of making headway in his efforts to give the Justice Department a bigger club to use on business and industry in civil antitrust investigations.

What Kefauver is after is authority for the attorney general to use a blanket-type subpena to force a company to produce its records.

The way it is now, this can be done only by a grand jury's investigating the possibility of criminal violations of antitrust laws.

Opponents of the legislation say it would simply give the Justice Department a hunting license so it could search through a company's records in hopes of finding the company guilty of something or other.

But the pending legislation (S. 167) has the strong support of Assistant Attorney General Lee Loevinger, Federal Trade Commission Chairman Rand Dixon, and others.

Attorney General Robert F. Kennedy has also urged its passage.

Limitations . . . In a hearing last week, Loevinger pointed out that under present law the grand jury cannot be used to investigate possible civil antitrust violations—only criminal ones.

Loevinger noted, too, that a 1958 Supreme Court ruling provides that it is an abuse of process to use a grand jury in an antitrust investigation where there is no intention to bring a criminal case.

As a result, Loevinger said, the department is now reluctant to file a civil case after a grand-jury investigation of possible criminal violations for fear of leaving itself open to the charge that the Government deliberately misused a grand jury's powers.

Loevinger said the authority being sought through the legislation would be particularly useful in the Government's attempts to block mergers.

"Unless the department can gather necessary information quickly, it cannot enjoin the consummation of mergers which may lessen competition," he said.

"Even after a merger has been consummated," he added, "time is of great importance. While investigations are delayed or stalled, the assets of acquired corporations can be intermingled with others."

Penal provisions . . . Loevinger also emphasized the importance of the penal provisions in the bill. These make willful obstruction of antitrust civil processes subject to criminal penalties.

Under such a law, a company's destruction of documents could be punished—as is now possible in criminal cases.

BRIEFS . . .

been increased from 50,000 to 55,000 bbl. daily. Revamping of the crude distillation unit raised its throughput 5,000 bbl. daily, and expansion of the fluid catalytic cracker.

Ralph M. Parsons Co., Los Angeles engineering and construction firm, has purchased Anaconda-Jurden Associates, Inc., a subsidiary of Anaconda Co. The Anaconda company builds and designs mining and metallurgical plants. Parsons will operate the company as a subsidiary under the name of Parsons-Jurden Corp.

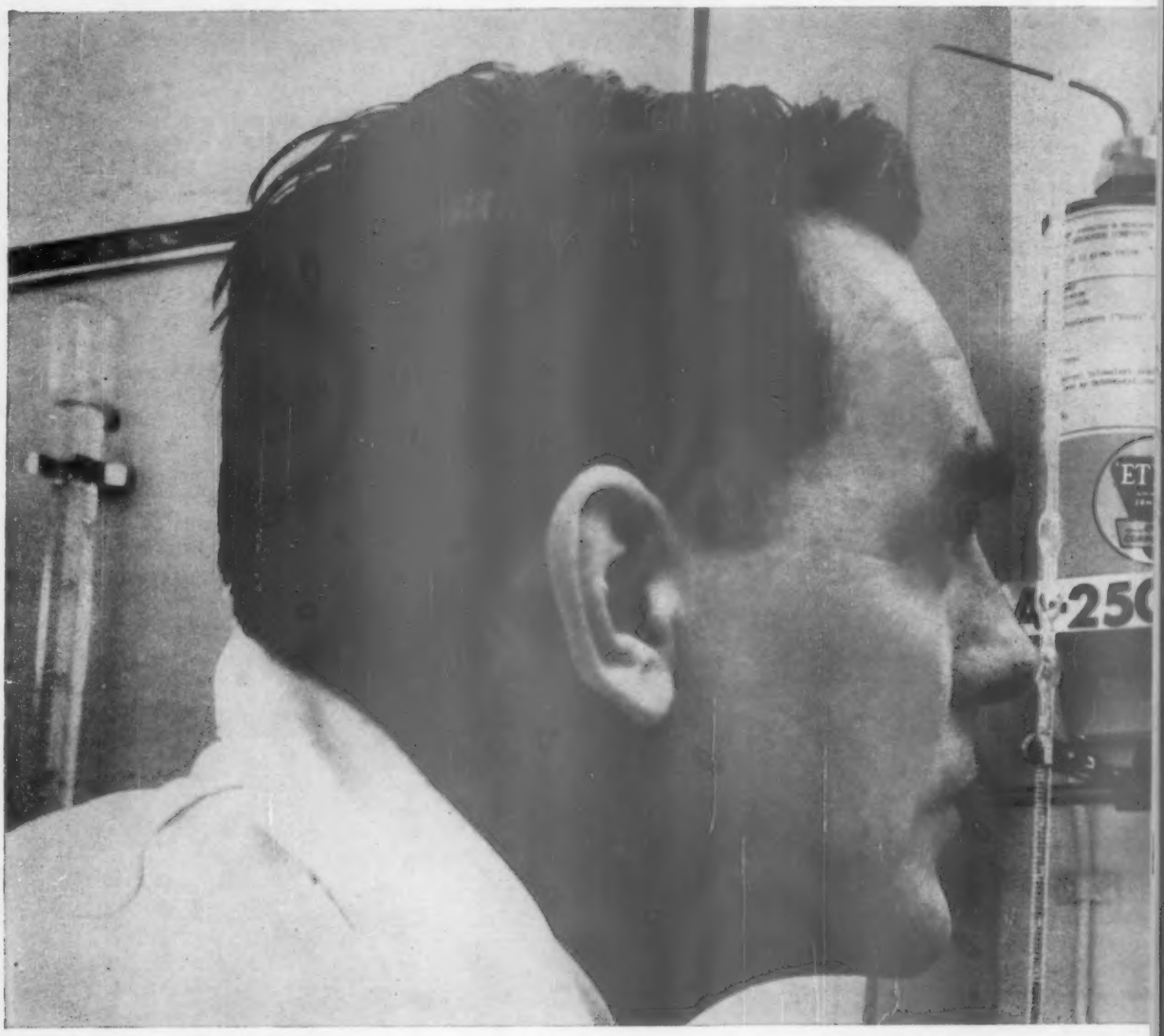
All working interest in the Fort Morgan field unit, gasoline plant and all facilities related to its operation, have been purchased by Natural Gas Producers, Inc., a wholly owned subsidiary of Colorado Interstate Gas Co. Also involved in the transaction were gathering line and compressor units serving the Opal and Young fields in Morgan County, Colorado.

Benzene concentrate is now being produced at Texas Gas Corp.'s Winnie, Tex., plant at a rate of 500 bbl. daily. Several process units were revamped and modernized to make the concentrate product. Work included retraying four fractionating towers, enlarging several pumps and reboilers, and installing a new heater.

Also for Refiners . . .

IN THE NEWS: Socal-Kentucky merger will mean end of Jersey deal to supply products to Kentucky and open big market to independent refiners (p. 81) . . . Refinery runs spurt past 8.3 million barrels daily for week as demand for products lags (p. 82) . . . Strike reaches critical stage at Phillips Chemical plant in Pasadena, Tex. (p. 90) . . . Both Japan and Italy are boosting processing facilities with new plants (p. 104).

PLUS THESE TECHNICAL REPORTS: New alky unit has compact layout, low maintenance (p. 143) . . . Sampling system vital in chromatographic control (p. 147).



ARE YOU

Until recently, selection of an antiknock was fairly simple. The refiner's problem boiled down to one of "how much?" Now it is not only "how much?" but "how much of which one?"

The wide range of antiknocks now available from Ethyl offers an opportunity to tailor antiknock selection to a particular refining situation. This is a complex problem, but its solution can be rewarding in terms of cost and/or improved gasoline performance.

As in the past, TEL is still the best compound for many refining situations. TML, with its increased volatility, provides superior performance in some fuels having high aromatic content or in engines prone to fuel segregation in the manifold. Mixed lead alkyls—equilibrium mixtures of TEL and TML—are offered in three formulations: "MLA-250," "MLA-500" and "MLA-750." These may provide road performance superior to that experienced with TEL alone. In addi-

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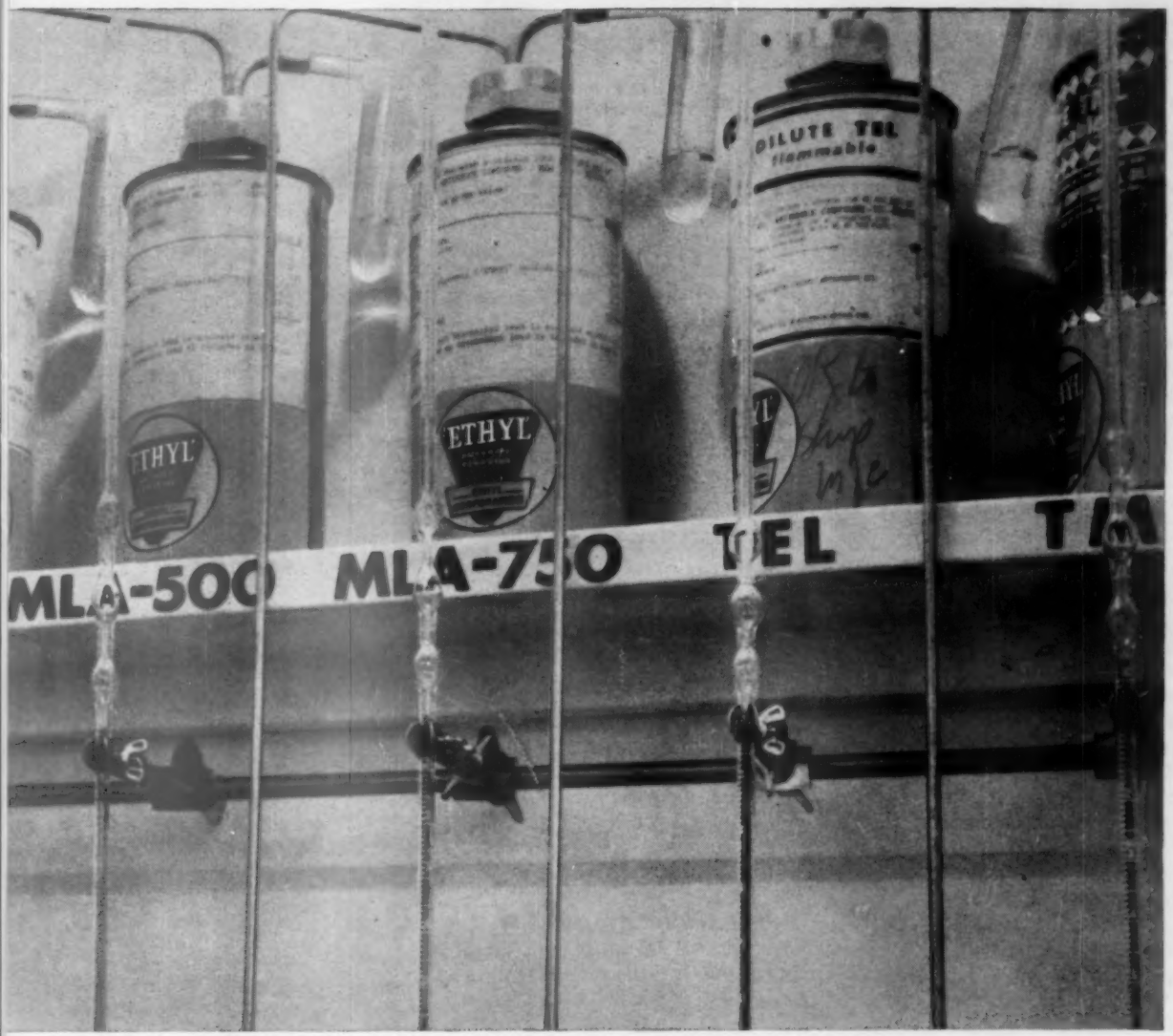

USING THE RIGHT ANTIKNOCK?

tion, "TELMEL" compounds—physical mixtures of TEL and TML—have also shown attractive road gains in some fuels while keeping costs to a minimum.

Several situations in which antiknocks other than TEL could prove advantageous were shown in a recent Ethyl study. One case involved a regular grade gasoline composed of straight-run and reformate. In the fuel tested, a "TELMEL" mixture would satisfy 18% more manual transmission cars than could be satisfied for the same cost using TEL.

Ethyl Corporation is eminently well equipped to assist the refiner in the selection of the proper antiknock to fit his technical requirements and marketing objectives. Extensive cooperative studies are now in progress with many refiners; others have been completed. If you have any questions involving the use of any of these compounds, call your Ethyl representative and he will be happy to provide assistance.

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Venezuelan Oil Minister Blasts Profits Tax

• Perez Alfonzo warns that proposed excess-profits levy would cripple nation's oil industry. Legislators may shortstop the measure.

VENEZUELA'S Minister of Mines went before the Chamber of Deputies in Caracas last week to battle a proposed excess-profits tax on the oil-industry, and apparently won his fight.

In an extraordinary closed-door session—the first in 25 years—Juan Pablo Perez Alfonzo told the Chamber the new tax would kill any incentive for further oil progress in Venezuela.

There were reports of spirited debate on the issue.

Caracas observers say Perez Alfonzo was able to swing a majority of the deputies to his side.

Whether he did or not won't be known until the Chamber takes final action on President Romulo Betancourt's "law of urgent economic measures."

The proposed excess-profits tax was added to the president's program by the Chamber. If it is dropped, it will be a victory for both Perez Alfonzo and Betancourt.

Last week's role was an unusual one for the slightly built, intense oil minister. He, as much as any man, is responsible for the current pessimism among private oil companies in Venezuela.

Perez Alfonzo is the unquestioned architect of a government oil policy that has curbed private oil activity to such an extent that the country is in dire economic straits.

His action last week cast him in a double role—oil minister and a powerful leader of Accion Democratica, the country's leading political party.

Perez Alfonzo and Betancourt feel the proposed new tax goes too far. Both have opposed the measure publicly, and have said the oil industry is now carrying as much tax burden as it can (OGJ, June 5, p. 53).

The final form of the proposed tax has never been made public, but Accion Democratica officials, endorsing the idea in principle, said they thought profits of an oil company above a fixed level should be taxed. A tax on earnings above a 15% return on investment has been discussed.

Both Perez Alfonzo and Betancourt opposed the entire idea of a tax on grounds that last year the oil industry as a whole earned only 11% on its investment in Venezuela.

Just a few days before the dramatic appearance of the oil minister before the legislators, the secretary-general of Accion Democratica issued a statement denying any rift between the party and the president over the issue.

Dr. Jesus Paz Galarraga said his party was not "discussing petroleum companies in general." He added:

"We quite agree that it is inadequate to raise the taxes of a company which is earning in Venezuela the same or a little more than in its native country. To apply this process is equivalent to eliminating the determining factor in the investment of foreign capital in Venezuela.

"But it is not absurd for an excess profits tax to be levied—after earnings reach a reasonable percentage—on a company which is earning in our country twice the profits it earns in its own, or make it reinvest said excess in Venezuela."

The excess-profits tax was proposed by the Chamber of Deputies' Finance Commission as an alternative to some proposals in President Betancourt's austerity program.

Adlai Bumps Into Venezuelan Oil Woes

ADLAI STEVENSON, President Kennedy's special envoy on a tour of Latin America, ran squarely up against oil problems when he made his first stop of the tour in Caracas.

President Betancourt made a formal request to Stevenson that the United States change its system of fixing imports of foreign oil.

He asked that the U. S. scrap its present law of allocating quotas to private-company importers in the U. S. Instead he wants quotas parceled out among exporting companies in places like Venezuela.

Dr. Juan Pablo Perez Alfonzo, Venezuela's Minister of Mines and Hydrocarbons, told Stevenson that the Venezuelan oil industry is being hurt by what he called a black market in the sales of import allocations by importers in the U. S.

Pakistan exults over prospects for Sui gas field

PAKISTANIS are beginning to think big about the prolific Sui gas field in the central part of West Pakistan.

Reserves in the gas pool have been revised upward to 9 trillion cubic feet, and Lt. Gen. Haji Iftikhar Ahmed, chairman of Karachi Gas Co., has made a glowing forecast of what this much gas can do for the country.

Using a hypothetical production figure of 600,000 M.c.f. daily, which Sui could supply for at least 40 years, the gas could support:

...**A petrochemical industry** that would produce 33 million pounds of carbon black and 22 million pounds of orlon annually.

...**A steel industry** using up to 100,000 M.c.f. of gas daily.

...**Fertilizer production** that

would allow application of nitrogen to all of Pakistan's cultivated lands at the same rate as in the U. S.

... **Exports** to India.

The field would last more than 400 years at present consumption of 22,000 M.c.f. daily.

This level of consumption has enabled Karachi Gas, an affiliate of Burmah Oil Co. to reduce prices.

Domestic consumers will now pay on a sliding scale of $1.68 to 84 cents per M.c.f. Commercial users will pay from 84 to 52½ cents per M.c.f.

Talks are going on from time to time between Pakistan and India for the sale of gas for use in India's Punjab, Rajasthan, and Gujarat regions.

A general agreement has been reached to the effect that it will be more feasible to tap Stanvac's Mari field, near the Indian border, which has been shut-in for a lack of a market.

Kuwait makes bow in petrochemicals with Italian firm

KUWAIT is putting itself into the petrochemicals business by forming a joint company with an Italian firm as a partner.

A governmental decree has authorized formation of Kuwait Petrochemicals Co., Ltd., with capital of $45 million. Its partner will be Oronzio de Nora, a Milan chemical construction company, which will hold 40% interest.

The Kuwait Department of Finance and Economy will hold 40%; the Kuwait National Petroleum Co., 5%; and Kuwait Industries Co., 3%. The remaining 12% will be offered to the public.

Oronzio will build a petrochemical complex based on Kuwait's natural gas.

In the first stage of construction, facilities will be built for the manufacture of caustic soda and chlorine, urea, polyvinyl chloride, ammonia, acetylene, oxygen, and hydrogen.

Most of the output will be exported.

The Kuwaiti move follows an agreement with Reynolds Metals for the construction of an aluminum smelter in the country.

Aramco Opening Another Field

• First commercial production planned in fall of 1962 at Abu Hadriya, which has been shut in for 2 decades.

ARABIAN AMERICAN Oil Co. will start flexing another of Saudi Arabia's producing muscles next year when it opens Abu Hadriya oil field.

The field, 100 miles northwest of Dhahran, is an old-timer by Middle East standards. It was discovered 21 years ago, but until last year it was shut in with only two wells.

Aramco has budgeted $2,350,000 to open the field to commercial production by October 1962. Plans call for an initial output of 50,000 bbl. daily.

Output will come from 7 wells.

The crude will be produced from Arab A and B members, and the Mid-Jubaila and Hadriya zones.

Abu Hadriya field straddles a pipeline that runs from Safaniya oil field to Ras Tanura, but the new crude will go through an 18,000-ft. feeder to the Qatif-Qaisumah line which ties into the Trans-Arabian Pipe Line (Tapline) system.

Tapline can move more than 400,000 bbl. daily of Saudi crude to a Mediterranean terminal at Sidon, Lebanon.

Abu Hadriya crude—after stabilization—will thus move directly to the Mediterranean, rather than to the Persian Gulf, for export.

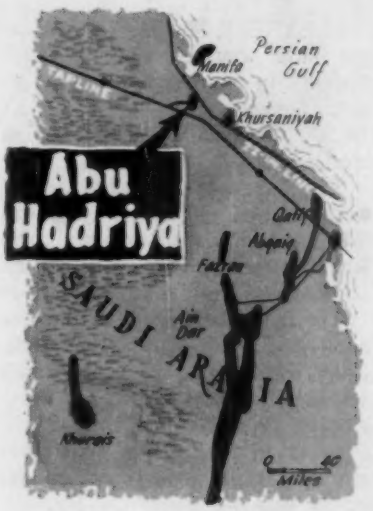
Aramco will build a gas-oil separator, stabilizer, and pump station near the dome of the field, about 3½-miles from the Qatif-Qaisumah line.

After two stages of separation, crude will flow directly to a heater. Next it will go to a stabilizer where the hydrogen-sulfide content of the oil can be reduced enough for sales without further treating.

Abu Hadriya crude will be mixed directly with other Arab Export crude in the Tapline system.

Most of the field processing units will be transferred from other Aramco facilities, where they are no longer needed because operating procedures have been revised and improved.

The facilities will include a high-pressure trap, test trap, 10,000-bbl. spheroid, stabilizer column, heater, stabilizer bottoms exchangers, diesel driver, shipping pump, and a diesel-driven generator.



Abu Hadriya will be Aramco's seventh producing field.

Others are Ghawar, which last year averaged 714,257 bbl. daily; Abqaiq, 299,714 bbl. daily; Safaniya, 181,000 bbl. daily; Dammam, 34,585 bbl. daily; and Qatif, 16,171 bbl. daily. Khursaniyah opened October 5 last year and averaged 5,562 bbl. daily the rest of the year.

Germany to get crude from Libya

CONTINENTAL Oil Co. has arranged to dispose of part of its newly developed Libyan crude in Germany, starting early next year.

The company announced it has made a long-term contract with Deutsche Erdol Aktiengesellschaft (DEA), Hamburg, to supply crude to DEA's Heide refinery and to another refinery at Karlsruhe, partly owned by DEA. The amount to be supplied was not stated.

Continental is the operator in Libya for Oasis Oil Co., owned jointly by Ohio Oil Co., Amerada Petroleum Corp., and Continental.

DEA and Continental recently joined in forming CONDEA, which will produce and sell petrochemicals in European markets.

Japanese Reworking North Sumatra Fields

• Indonesian Government finally allows operations in two nationalized fields once owned by Shell group. Crude output will reimburse Japanese for credit.

JAPANESE drilling operations got under way last week in North Sumatra in a program designed to give Japanese refiners at least 14,500 bbl. daily of Indonesian crude within 3 years.

The Japanese oil men are reworking two old fields in North Sumatra which were owned by the Royal Dutch-Shell Group before the outbreak of World War II.

The fields were never returned to Shell and were nationalized officially by Indonesia in February 1958. They are now being operated on a limited basis by P. T. Perusahaan Minjak National (Permina), a government company set up for that purpose.

Work began last week under an agreement between the Japanese-owned North Sumatra Oil Development Cooperation Co., Ltd., and Permina. The Japanese are advancing Permina credits and assistance worth $52.3 million over a 10-year period. They will be repaid in oil.

The agreement . . . The start of actual drilling marks the fruition of long and repeated efforts on the part of several Japanese groups to make a deal with the nationalistically minded Indonesians to develop the North Sumatra area.

The new North Sumatra Oil Development company was formed after A. Kobayashi, a Japanese business man, finally worked out the financing of the development with Indonesia.

Under terms of the agreement, the Japanese company is to receive at least 40% of all the increased crude production in the area over a base figure of 5,000,000 bbl. a year (about 13,700 bbl. daily).

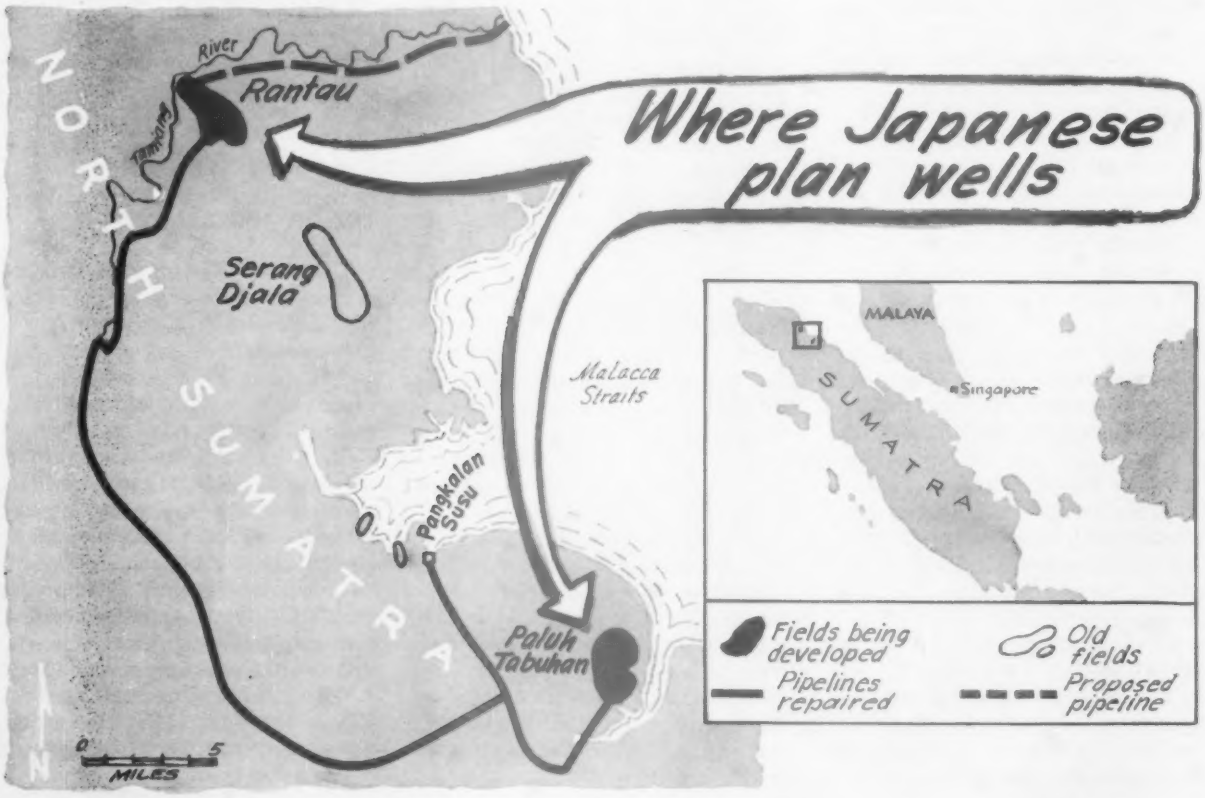
After annual production reaches 15.7 million barrels, which the Japanese expect by 1964, a minimum of 14,500 bbl. daily will be shipped to Japan. If regular production rises above the 43,000-bbl.-daily level, the Japanese share of the excess is subject to negotiation.

The Japanese plan to spend $12.8 million in 1961. The remainder of the $52.3 million they have agreed to provide will be strung out over the remaining 9 years of the contract.

Five drilling rigs—three light rigs rated for 2,000 ft. and two designed for 5,000-ft. depths—will be shipped to Indonesia before the end of 1961. Nine technical advisors, plus about 40 engineers and drilling crewmen, are already in North Sumatra working with Permina.

A Royal Dutch-Shell company at one time produced half a dozen fields in the area involved in this contract, but the bulk of the work planned by the Japanese will be done at Rantau and Paluh Tabuhan fields in North Sumatra.

Permina has already reworked 71 Rantau wells and 9 more at Paluh Tabuhan. The Japanese plan to drill 24 new wells at Rantau and 1 in Paluh Tabuhan. They will re-



work another 20 in Rantau and 8 at Paluh Tabuhan.

Crude produced at both fields is being moved through a reconstructed pipeline system to Pangkalan Susu on the Malacca Straits, where it is picked up by small coastal tankers. Original plans were to expand this transportation system, but the group is now exploring the possibility of building a new pipeline and loading terminal.

The new plan would involve building a pipeline to the mouth of the Tamiang River. This line would serve a submarine pipeline to a berth offshore which would accommodate ocean-going tankers.

The Japanese imported about 3,400,000 bbl. of North Sumatra crude last year in outright purchases from Pembina. They should be able to ship at least 300,000 bbl. of their own crude to Japan before the end of this year. And even more if they are able to boost production high enough.

Even if the most optimistic estimates of the North Sumatran properties prove to be true, the 15,000 bbl. daily or so which the Japanese company will ship to home refineries will be only a drop in the Japanese-demand bucket.

Traditionally the Japanese have gone to the Middle East for 80% of their crude requirements. They have confined imports of lighter, low-sulfur Asian crudes to about 15% to help balance the heavier, sour Middle East oil. Russian crude is already beginning to fill the gap between the two.

If the present Japanese administration succeeds in its ambitious plans to double Japanese income within 10 years, the country will be importing an estimated 1,720,000 bbl. of oil by 1970. This makes the expected volume of North Sumatran crude look even smaller than it does at present.

Deviated Well Eyed for Wild Khafji Hole

A DIRECTIONAL WELL may be drilled in an attempt to kill a wild well in the Persian Gulf that has been on fire since April 28.

Tokyo-based Arabian Oil Co. is considering transfer of a rig on Khafji 16 off the Neutral Zone to a location near No. 15. From this location a deviated well would be drilled into the out-of-control hole.

No. 15 caught fire when it encountered a high-pressure Eocene gas sand at 1,700 ft. The rig was damaged but the drilling tender escaped. The well has been abandoned.

The same high-pressure sand caused trouble in the No. 1 Khafji in 1959. That well was brought under control, however, and was drilled on to become a 6,000-bbl.-daily discovery which paved the way for the first Japanese production in the Middle East.

India Demands a 50-50 Pattern

. . . for exploration, production programs. New deal with Burmah Oil shaves company ownership in joint operations.

THE DIE has been cast for future exploration programs in India.

A new agreement between the government and Burmah Oil Co. gives India a 50%—instead of one-third—interest in exploration and production carried on by a joint operating company—Oil India Private, Ltd.

The new 50-50 partnership will set the pattern for future exploration agreements with foreign companies, according to Keshav Dev Malaviya, minister for mines and oil.

Some other provisions in the new agreement:

. . . **Burmah Oil gains** a half interest in an 1,800-sq.-mile exploration concession in Northeast Assam. This originally was awarded to Oil India Private. Burmah Oil has sought rights to the area for years.

. . . **Burmah Oil loses** part of its interest in the prolific Nahorkatiya-Hugrijan-Moran producing area in the same region of Assam. Its two-thirds interest has been watered down to a half interest by India's increased ownership of Oil India.

. . . **Some tax relief** is granted in a provision allowing the company to write off pre-production costs against revenues for income-tax purposes. This is expected to cut over-all taxes on operations from 63 to about 60% of net.

. . . **Price of any new** commercial production will be based on the laid-down cost of crude imports. Burmah Oil will cede the government an unspecified price discount.

. . . **Nahorkatiya** and adjoining licenses will supply crude for a 720-mile 14 and 16-in. pipeline system that will carry up to 80,000 bbl. daily (OGJ, Mar. 13, p. 108).

. . . **Burmah Oil will supply** the foreign exchange needed to develop any new fields. India will supply rupee financing.

. . . **The posts** of chairman and financial director of Oil India Private will be held alternately by nominees of the government and of Burmah Oil.

As a side issue, the government reportedly has agreed to refrain from marketing products in Assam from its new Nunmati refinery, now under construction. The state is now fully supplied by a refinery operated by a Burmah Oil subsidiary, Assam Oil Co. Refinery runs average about 8,500 bbl. daily.

India also is said to be offering Burmah Oil similar terms for a concession in the Jaisalmer region of Rajasthan, in northwestern India.

U. S. offer . . . The United States Government has approved financial assistance for the first time for India's government-run exploration program.

India has accepted the U. S. offer in principle and the country's Oil & Natural Gas Commission has been asked to prepare a special program to make use of the funds.

The funds will be made available through the Import-Export Bank, under a reversal of U. S. policy which now permits financial aid to government oil operations.

Two Plants Hike Japan's Processing Capacity

TWO NEW refineries are giving another boost to Japan's booming processing industry.

One of the plants, a 40,000-bbl. refinery at Mizushima, Okayama Prefecture, has already been put on stream by Mitsubishi Oil Co.

The second plant, across Mizushima Bay from the Mitsubishi project, will be placed on stream this month by Nippon Mining Co. It will have an initial capacity of 30,000 bbl. daily.

The plants lie between the industrial areas of Osaka-Kobe and North Kyushu. They will supply products to both areas.

Osaka and Kobe are on Honshu, the main island of Japan. Kyushu is Japan's big southern island.

Tidewater Oil has 49% interest in Mitsubishi Oil.

Nippon Mining is a Japanese independent.

The two plants increase Japan's total capacity, which at the start of the year was 683,670 bbl., by more than 10%.

Mitsubishi facilities . . . The Mitsubishi refinery has a 40,000-bbl. two-stage distillation unit, a 40,000-bbl. Petreco crude desalter, a 2,000-bbl. Merox gasoline - treating unit, a 7,200-bbl. Unifining unit, and a 3,600 - bbl. Unifining - Platforming unit.

A second stage of construction in 1962 will include a 7,600-bbl. fluid cat cracker, a 5,700-bbl. fluid coker, a 4,200-bbl. Unifiner to handle No. 2 middle distillate, and a 63-ton-daily sulfur-recovery and hydrogen-manufacturing unit.

Eventually Mitsubishi plans to have a 200,000-bbl. refinery at Mizushima that will be integrated with a petrochemical complex operated by an affiliated firm, Mitsubishi Kasei KK.

A petrochemical- construction program to be completed by January 1964 will include facilities for producing 43,100 tons per year of ethylene, 33,200 tons of propylene, 63,200 tons of acetaldehyde, 15,000 tons of acetone, 7,200 tons of acrylonitrile, 6,000 tons of octanol.

The new $22.2-million refinery is Mitsubishi's second in Japan. The company's existing 51,620-bbl. plant is at Kawasaki.

Nippon Mining . . . Downstream units at Nippon Mining's nearby refinery include a 6,000-bbl. Houdriformer, a 2,500-bbl. Unisol gasoline treater, a 2,000-bbl. Unifiner, and a 30-ton-daily liquefied-petroleum-gas recovery plant.

The company reportedly is planning to add a 100,000-bbl. topping unit by 1963. This will increase capacity of the refinery to 130,000 bbl. A naphtha-cracking unit for producing 80,000 tons per year of ethylene also is planned.

Nippon Mining already operates a 19,350-bbl. refinery at Funakawa.

LEANING TOWER illusion at Mitsubishi Oil's new 40,000-bbl. refinery in Mizushima is created by unusual camera angle.

Italian refining industry gets okay for new projects

ITALY has approved eight projects that will mean a major round of expansion for the country's big refining industry.

Four of the projects call for entirely new refineries.

ANIC, an ENI company, has permission to build a 40,000-bbl. plant in the Po Valley. SORAP Edison will build a 60,000-bbl. plant in northern Italy. Mediterranea Petroli will build a 20,000-bbl. refinery in Sardinia, and CLASA a 20,000-bbl. plant near Rome.

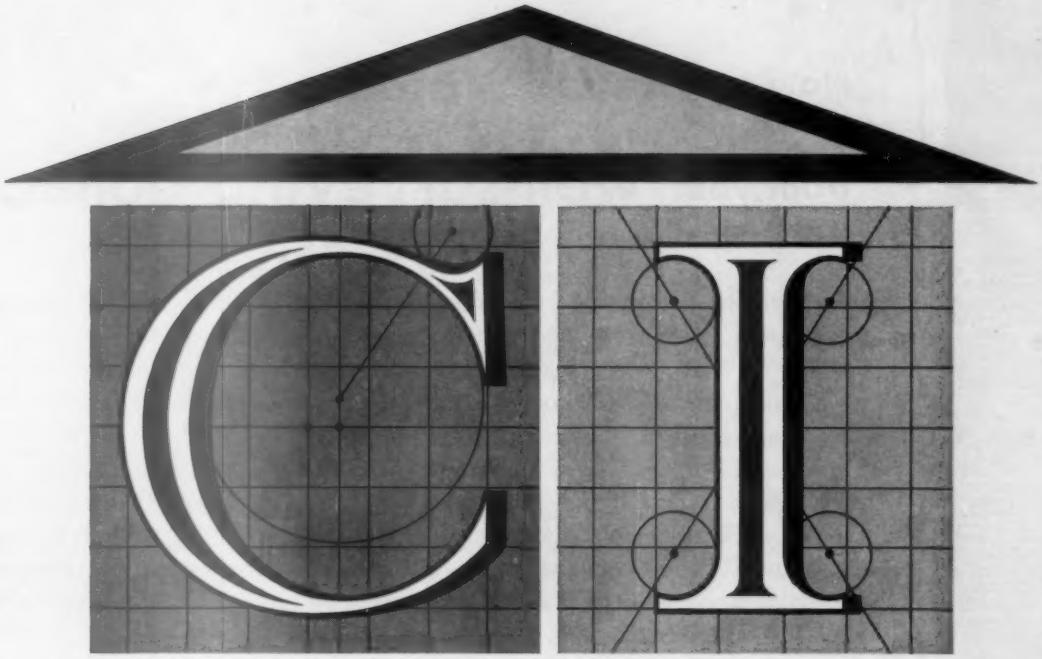
The four other projects call for expansion of existing refineries.

Shell Italiana has permission to expand its Condor plant, near Milan, to 80,000 bbl. Italia-Amoco will expand a refinery at Cremona to 60,000 bbl. DICA will dismantle its Carrara refinery and move it near Rome, where it will be expanded to 60,000 bbl. ICIP's Mantua refinery will be enlarged to 40,000 bbl.

The new projects reflect Italy's fast-growing inland demand, which by 1967 is expected to reach 720,000 bbl. daily.

This compares with inland demand last year of 370,000 bbl. daily. Bunker sales and product exports raised over-all demand to more than 560,000 bbl. daily.

Italy's total refining capacity is rated at 818,600 bbl. daily, but this includes spare capacity required by government regulations.



Two of Canada's chartered banks—The Canadian Bank of Commerce and the Imperial Bank of Canada—have come together under one roof. The name is new: Canadian Imperial Bank of Commerce. But the amalgamation it represents is a bringing together of two long-established banking traditions.

With more than 1,240 branches across Canada, at certain points in the U.S.A., in the Caribbean area and in London, England, Canadian Imperial Bank of Commerce has the largest branch network of any Canadian bank. It is admirably equipped to help you with your business in Canada or overseas.

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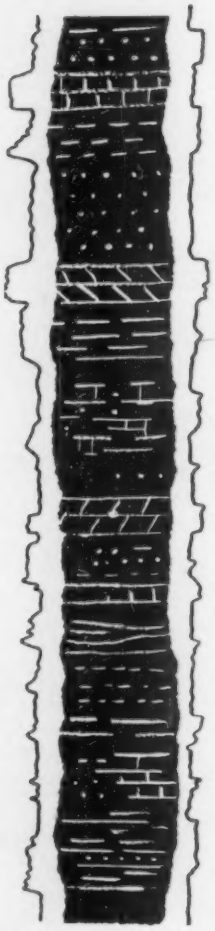
For facts on Canadian Oil and Natural Gas, write either to

Petroleum and Natural Gas Department
Canadian Imperial Bank of Commerce
309 Eighth Avenue West
Calgary, Alberta, Canada

or Mr. John P. Moreton
Resident Representative
Canadian Imperial Bank of Commerce
1512 Commerce Street, Dallas, Texas

SPECIAL
REPORT



How to get full value from your well-surveying dollars

HERE is a three-part package on well logging. Purpose is to increase your return from the money spent on formation evaluation.

First, use the logging method, or methods, that will give best results for particular well conditions and formation types. This done, the economic battle is half won.

From what you'll learn in the second part of this series you will get a better interpretation on your next job and possibly "salvage" some of the money already spent. True resistivity is needed for best evaluation of conventional electric logs, and, lacking these data, you may pass up a couple of good producing zones. This article could point out some good production that is yours for the taking.

Increased use of air and gas for drilling means that conventional tools and methods must give way to newer developments. Operators in cable-tool country will find comfort in the third part of this series also. It brings you up to the minute on empty-hole logging.

But first things first. Get started on the right foot. . . .

Use the right log

BY W. B. BLEAKLEY
Production Editor

GOOD WELL LOGS are cheap. But the wrong log for existing well conditions is a waste of money.

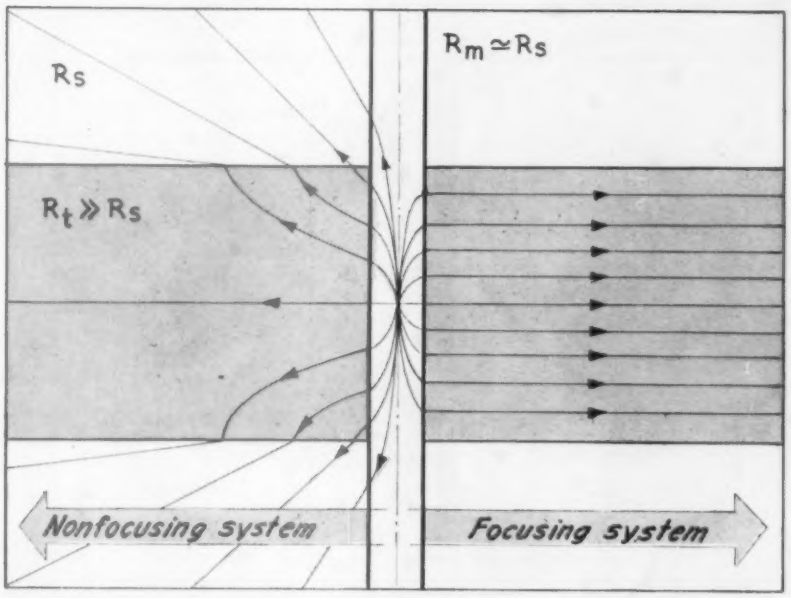
Each type of log is designed for use under certain conditions, and when these conditions exist, that type of log should be used.

Not too many years ago, the conventional electric log was the standard of the industry, and the operator had very little choice. Several different companies could provide the needed service, and the results were similar. But the recording and detecting equipment differed from one company to another, and operators made decisions based on these small differences.

But, basically, all logs were of the electric type, they showed about the same information, and they measured the same reservoir properties — potential and resistivity.

New methods. In the last 15 years or so there have been many advances in well logging. So many, in fact, that most operators have a hard time keeping up with the new developments. Each producing company needs a logging expert, or must frequently call on consultants to get the proper interpretation.

But proper interpretation must



NORMAL DEVICE for measuring resistivity sends current along smooth circular paths if the medium is homogeneous, and of infinite thickness. Left side of the sketch above shows current lines from a normal device (nonfocusing) in a borehole opposite a formation whose resistivity is greater than that of the drilling fluid, and also greater than that of the adjacent beds. On the right side, current lines from a focused electrode device are shown for comparison. In the normal device, the current lines have a tendency to bypass the more resistive bed, and move into the less resistive adjacent beds. This results in an apparent resistivity that is less than the true resistivity of the bed under investigation.

start at the beginning—with the right log. The purpose of this article is to show what log should be used under what conditions.

Let's Define Some Terms

To be sure we are all talking about the same thing, let's look at those things that make up well conditions, and describe them in understandable language.

Drilling fluid. The contents of the bore hole make up the medium that the logging tool works in. Obviously this fluid has a lot of influence on the results of the logging job.

Drilling fluid can be either oil, air, or water, in a broad sense, or almost any combination of these, along with any or several of a vast number of different additives.

Drilling mud is generally a water-base fluid containing additives for viscosity and weight control, and for control of other properties that will improve its functions as a drilling agent. If the salinity is less than 20,000 p.p.m., it is classed as a fresh mud, and if more than 20,000 p.p.m., it is a salt mud. Another way to distinguish fresh mud from salt mud is through the resistivities of mud filtrate, R_{mf}, and formation water, R_w. If the ratio R_{mf}/R_w is less than 4, logging is done on the basis of salt mud, rather than on a fresh mud.

Oil-base muds are those in which the fluid matrix is a nonconductive oil. Wells containing oil-base muds must be given special consideration, because many logging devices depend on drilling-fluid conductivity. Since oil-base muds have extremely high resistivity, conventional electric logs are not recommended.

Some of these same remarks apply when a well is drilled with air or gas. The lack of conductivity of the fluid in the well makes the electrical log unusable.

Casing. When a bore hole is already cased, all types of electrical tools are eliminated from the list of possibles. Only radiation-type surveys can be made.

Formation type. Main property of formations that has an important effect on well logging is consolidation. Some consideration must be given to limestone as opposed to sandstone, but this will be covered under the discussion of particular logging tools.

Three classes need to be considered; unconsolidated formations, medium formations, and hard formations. The degree of consolidation is a measure of the amount of cementing material between the sand grains, and is usually a function of geologic age. Older rocks are generally harder as a result of better cementation.

LOGGING METHODS

Several different tools have been designed to measure only a few properties of the rock material in the well bore. But these tools measure in different ways—each tool being designed to do a special job.

Electric logging measures two properties—resistivity (or conductivity) of the fluid in the well bore and the surrounding rock material, and the spontaneous potential generated in the borehole. There are a number of tools that measure these same properties, but the resulting logs have completely different appearances, because of the way in which these properties are measured.

Radioactivity logging measures the natural radioactivity of the formations, and also the effects of bombardment of the formations by neutrons. Each of these produces a trace on the finished log.

Acoustic logging involves the measurement of the velocity of sound across the formation.

Let's look at the different log types, to learn what they measure and how, and to see what conditions are best suited for their use.

Electrical Log

The original electric logging tool had only one resistivity-measuring electrode. Newer sondes are capable of recording two types of resistivity curves as well as the spontaneous potential of the formations. Some tools record as many as five curves simultaneously.

Spacing of the electrodes in the instrument determines the radius of investigation of the tool. Two normal devices, with electrode spacing of 16 and 64 in. are commonly used, and a lateral device with about a 19 ft. spacing is included.

These dimensions vary geographically, and from one logging company to another. In the Pacific Coast area, the long normal on one tool is absent, and is replaced by a short lateral (6 to 9 ft.) and the long lateral measures 18 ft. 8 in. In the

Permian basin, the short normal is reduced to 10 in. and a limestone device is used instead of the long normal. These are just examples of the many variations available.

Short electrode spacing means that the depth of penetration into the formation is limited. A short normal curve, for example, while useful for finding boundaries of beds, is affected by invasion, and measures the resistivity of the invaded zone. This is not detrimental, however, because the effect of invasion is needed in the interpretation of the other curves.

The long normal is not as useful for finding bed boundaries, but is better suited for finding R_t, the true resistivity of the formation, in thick beds. This is especially true in beds of low or moderate resistivity.

The lateral curve will detect thin, resistive beds better than the other two, but does not give good definition to these beds under some conditions. In case of deep invasion it is well suited to the determination of R_t, if the beds are fairly thick and homogeneous.

Newer devices are gradually replacing the conventional electric log as the standard of the industry.

Electric-survey limitations. Factors affecting resistivity measurements include electrode spacing, mud resistivity, bed thickness, and, the beds above and below the formation under study.

The conventional devices are thus not suitable for correct interpretation of thin beds. This is particularly true in hard-rock country where resistivity contrast between beds is great, or where a large difference in resistivity exists between the formation and the mud.

New tool. One of the latest developments in electric logging is a tool that is run in the hole inside drill pipe. It has a flexible wandlike electrode assembly that protrudes through one of the jets in the drilling bit.

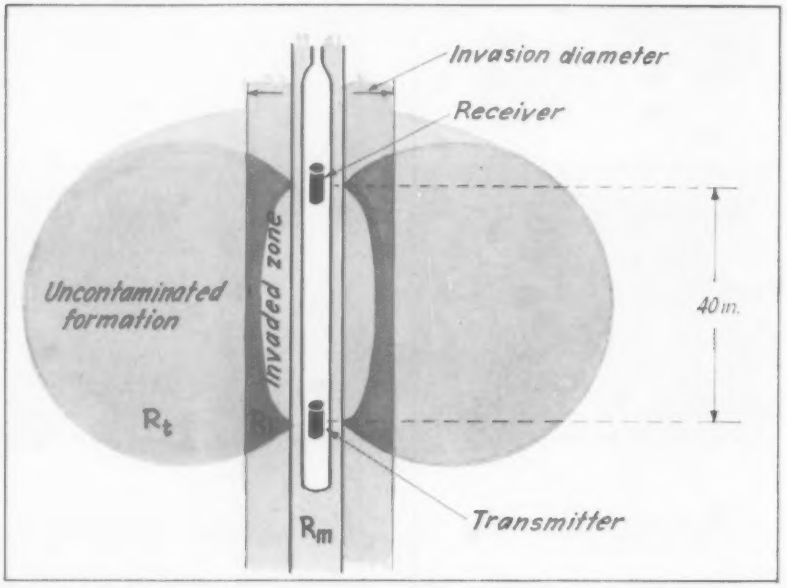
Unit is self-contained, and the logging results are recorded on a magnetic tape inside the tool's 2⅛-in. diameter. Instrument will record a spontaneous-potential curve and 16 and 64-in. normals.

The tool is pumped down the drill pipe, and its arrival on bottom is shown by an increase in pump pressure. The wand assembly is 27 ft. long, and the drill pipe must be raised that much before the tool is put in place.

Log can be run as drill pipe is being taken out of the hole. If the rate is about 60 ft. per minute, the tape supply in the instrument will take care of about 2,500 ft. of hole.

The tool can also be lowered to log a short interval, in which case the drill pipe is simply raised in the elevators through the desired distance. The logging tool can be retrieved by a wire line, and drilling resumed.

Magnetic-tape playback produces a conventional strip-chart log.



DOUGHNUT SHAPE is characteristic of the volume of material investigated by the induction log. Good value for true resistivity is obtained because the volume of invaded zone, compared to the total volume, is small.

Induced-Current Logging

Use of oil-base mud is largely responsible for development of the induction type of well survey. Conventional resistivity curves cannot be run in a nonconductive fluid. On the theory that water invasion damaged oil reservoirs in the vicinity of the well bore, oil-base mud became popular, and a new logging system was needed.

Insulated electrical coils mounted on the logging tool induce currents in formations penetrated by the borehole. Proper design and placement of these coils limits the response in the formations to a horizontal slice of limited thickness. Effect of drilling fluid and adjacent beds is reduced to a minimum or eliminated altogether.

Soft or moderately consolidated formations drilled with fresh mud are particularly well suited for investigation by induction methods. And the results are usually more reliable than those from a conventional resistivity log even in hard formations.

Geometry of the induction instrument permits simultaneous recording of a 16-in. normal curve and an SP curve.

Limitations. In large boreholes, or where the drilling fluid is not very resistive, or where bed resistivity is high, the total signal contributed by the mud column becomes large. This diminishes the effect of formation characteristics, and makes interpretation difficult or unreliable.

To counteract these effects, spacers are usually used to keep the tool centered in the hole. Newer tools have been designed to minimize the effect of hole size.

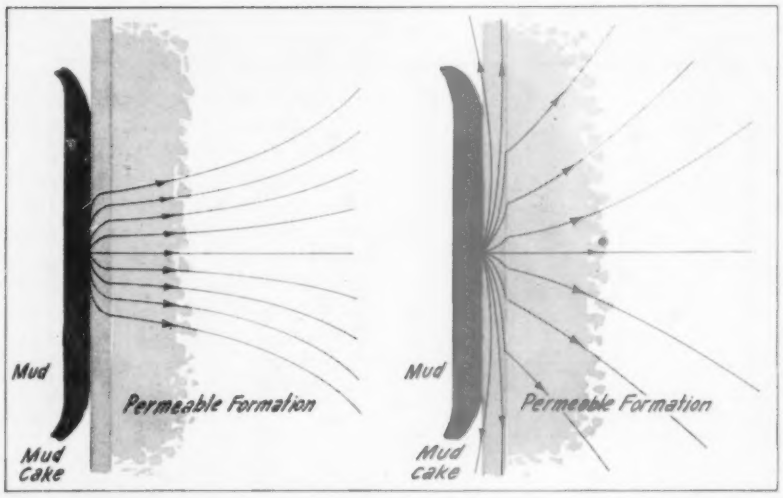
Thin, hard streaks are frequently used as markers, but the induction device is not well suited for their detection. On the other hand, when these streaks are adjacent to porous and permeable formations, the readings are not affected by their presence. With conventional resistivity devices, these streaks cause serious interference.

Application. True resistivity is one of the most difficult properties of a rock formation to obtain with a conventional electric log, unless

Summary of logging methods recommended for various well conditions and formation types

Drilling fluid and borehole conditions	Type of Data Wanted	TYPE FORMATION: High Porosity Unconsolidated Formation	Medium Formations	Low Porosity Hard Formations
Open-hole fresh mud	Lithology, resistivity	1. Induced current and electrical log* 2. Electrical log	1. Induced current and electrical log* 2. Electrical log.	1. Induced current and electrical log* 2. Focused resistivity log 3. Electrical log (Radioactivity log may be used for lithology)
	Porosity	1. Microresistivity log—caliper 2. Velocity log—caliper 3. Density log—caliper	1. Velocity log—caliper 2. Microresistivity log—caliper 3. Density log—caliper	1. Velocity log—caliper 2. Density log—caliper 3. Neutron log 4. Microfocused resistivity log—caliper
	Permeability indication	1. Microresistivity log—caliper 2. Density log—caliper	1. Microresistivity log—caliper 2. Density log—caliper	1. Microresistivity log—caliper 2. Microfocused resistivity log—caliper 3. Density log—caliper
Open-hole salt muds $R_{mf}/R_w < 4$ or mud salinity > 20,000 r.p.m.	Lithology, resistivity	1. Electrical log 2. Induced-current and electrical log* 3. Focused resistivity log (Radioactivity log may be needed for lithology)	1. Focused resistivity log and gamma ray 2. Electrical log and gamma ray	1. Focused resistivity log and gamma ray
	Porosity	1. Microresistivity log—caliper 2. Velocity log—caliper 3. Density log—caliper 4. Microfocused resistivity log—caliper	1. Velocity log—caliper 2. Microfocused resistivity log—caliper 3. Density log—caliper 4. Neutron log	1. Velocity log—caliper 2. Density log—caliper 3. Neutron log 4. Microfocused resistivity log—caliper
	Permeability indication	1. Microresistivity log—caliper 2. Microfocused resistivity log—caliper	1. Microresistivity log—caliper 2. Microfocused resistivity—caliper	1. Microresistivity log—caliper 2. Microfocused resistivity log—caliper
Open-hole oil-base muds	Lithology, resistivity	Induced current log and gamma ray		All Formations
	Porosity	1. Velocity log-caliper 2. Density log-caliper 3. Neutron log		
	Permeability indication	None		
Open-hole air or gas	Lithology, resistivity	Induced current log and gamma ray		
	Porosity	1. Density log—caliper 2. Neutron log		
	Permeability indication	Temperature survey		
Cased hole	Resistivity	None		
	Lithology	Gamma ray		
	Porosity	Neutron		
	Permeability indication	None		

*Induced-current log is usually run with an SP log and a short normal.
Choice of logging method listed in order of preference.



CURRENT LINES from a microfocused resistivity device, left, move into the formation in a disklike manner, with limited vertical distribution. The microresistivity device, right, sends current in all directions from the source point. Distribution of these current lines is affected by comparative resistivities of the mud cake and the formation, and by the resistivities of adjacent beds.

the formations are massive and homogeneous. But it is easily found by the focused characteristics of the induced-current survey. This is particularly true for thin beds in wells drilled with fresh muds.

Combining the induction, 16-in. normal, and SP curves gives one of the most reliable tools now available. This combination works well except that the readings from the normal curve are suspect for thin beds whose resistivities are in sharp contrast to adjacent beds. But, results are better than from a conventional tool under same conditions.

Focused Electrode Logging

This system uses focused electrodes to find resistivity by measuring current forced through the formations as a disk of predetermined thickness. A portion of rock of limited vertical extent is measured, and the results are not greatly affected by the mud column.

Vertical flow of impressed current is prevented by continuously varying current in other electrodes strategically placed in the sonde.

Limitations. When invasion is deep, usually the case in hard formations, influence of invaded zone on apparent resistivity becomes important.

If a comparatively fresh mud is used, and a formation containing highly saline water is drilled, the resistivity of the invaded zone is higher than the true resistivity, R_t, for the water-bearing formations, and about equal to R_t for oil-bearing formations. Thus most of the resistance is located in the invaded zone, and the log will read about the same in both cases. This makes it difficult or impossible to distinguish between oil and water saturations.

Applications. From the above it is seen that focused electrode logging is well suited for use with salty muds. Resistivity of the mud filtrate should be less than 4 times that of the formation water.

In formations containing relatively fresh water, and where wells have been drilled with fresh mud, this type of log is recommended as a basic tool. When mud and formation-water resistivities depart from the ideal, it is still useful in hard-rock country for the definition of beds and for correlation.

Microresistivity Logging

The microresistivity device contains three small electrodes spaced a short distance (about 1 in.) apart on a vertical line. They are located on a rubber pad that is held in contact with the side of the borehole, by pressure from springs built as part of the sonde.

The rubber pad insulates the electrodes, so that short-circuiting of the impressed current through the drilling fluid is prevented.

One of the electrodes is the current source. Potential difference is measured between the other two, (inverse curve) and between one of these and the surface, (normal curve). The tool yields resistivity curves which are measured from a small volume of material.

On the side of the tool opposite the electrodes is a second shoe, or skid. Spring pressure forces this and the electrode pad in opposite directions, so both bear on the sides of the hole. The distance between these points is recorded simultaneously with the resistivity curves, and the result is a caliper survey of the hole.

The arms supporting the rubber pads or skids are sometimes collapsible, and are kept in the closed position as the tool is lowered in the hole. The actual log is recorded as the tool is coming out of the hole in the usual manner. But, a record is frequently made on the trip down, to investigate the resistivity of the drilling fluid under actual hole conditions. With the tool collapsed, the electrodes are far away from the wall of the hole, and their radius of investigation is small enough so that only the drilling-fluid resistivity is measured.

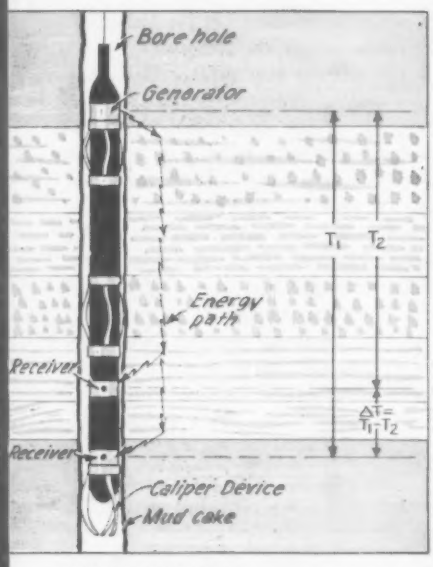
Limitations. Because this device depends on conductivity of the drilling fluid, it is not usable in wells drilled with oil-base mud, or with air or gas. Also, porosity must be above about 15% for accuracy.

Applications. Microresistivity logging is particularly suited for permeability indication in all types of formation, whether the mud be fresh or saline. The caliper log is considered an essential part of the total survey. Porosity determination can be made in unconsolidated formations and in medium formations if the mud is not too salty.

Short spacing of electrodes makes the tool useful in detecting the presence of thin beds. Wider electrode spacing, as in the conventional electric logging tool tends to average out the effects of thin beds, and they remain undetected. But the radius of influence of the microtool is so small that beds a few inches thick can be found if their characteristics differ from adjacent formations.

Microfocused Resistivity Logging

Like the microresistivity tool, the microfocused instrument makes use of an insulating pad held against the wall of the hole by a spring system. The big difference is that the electrodes are arranged concentrically, forming a focusing system that re-



ENERGY WAVES from the generator of a velocity logging device take the **fastest** path to the receiver, not the **shortest.** The fastest path is shown as the one through the drilling fluid and mud cake to the wall of the hole, and then down through the rock formations, across the mud cake again to the receiver. The measurement of interest is the difference in travel time between the two receivers.

stricts current flow to a narrow beam. The tool minimizes the effect of filter cake, and makes it negligible if the cake is thin. Because of this, the tool is particularly good for finding R_{xo}, the resistivity of the flushed zone.

Limitations. This tool gives only a single curve on the surface recording instruments, and is therefore used to supplement other log types. In porous and permeable formations, if mud-cake thickness is greater than ⅜ in., its effect is no longer negligible, and appropriate charts must be used for correction. Special tools are also available for extra-thick mud cake. But mud-cake thickness must be known, and there is no way to measure this except with a caliper log, and then the results must be used with caution. The tool cannot be used in wells drilled with oil-base mud or air.

Applications. The current beam has a diameter of about 2 in., so the resolution of the tool is very great. It provides sharp definition of boundaries of beds where thickness is as little as 2 in.

In surveying tight formations where mud cake thickness is no problem, the curve gives a direct value for R_{xo}, the resistivity of the flushed zone.

Radioactivity Logging

Two types of radiation are used to make up a complete radiation log. One is the natural radiation of the earth's formations (gamma rays) and the other is an induced radiation—caused by bombarding the rock layers with neutrons.

Gamma radiation is measured in both cases, but the source and intensity is different.

Natural gamma radiations vary with the content of earth materials. Shales have more of the naturally radioactive materials than sandstones and limestones, making the radiation survey useful in distinguishing between different types of rocks. In this connection, the natural radiation survey is similar in function to the SP curve.

Travel of gamma rays, except for intensity, is unaffected by the presence of casing in a well, or by the type of drilling fluid. So this type of survey can be made inside casing, with the well full of oil-base, fresh or salty mud, or even air (or gas).

Neutron logging is based primarily on hydrogen content. Neutrons from the sonde are slowed down and captured quickly when the hydrogen content of a formation is high. So the neutrons available for bombardment to release gamma rays are reduced in number, resulting in a low response. The counting rate at the detector increases for decreasing hydrogen content of the formations and vice versa.

Shale contains a large amount of hydrogen in the form of water of hydration, and so do porous sandstones containing water or oil. The gamma-ray survey will detect the difference between shale and sandstone (or limestone) but neutron logging can't differentiate between oil and water.

A sharp distinction is made between gas and water, or between gas and oil, however. Hydrogen concentration in gas is much less than in oil or water, and an increased reading on the log results.

Limitations. Neutron-derived porosity can sometimes be misleading. If the gamma survey shows a formation to be sandstone, and that sandstone is a dirty one, having a large percentage of shale in it, the neutron curve will respond to the hydrogen content of the shale, giving a high reading of porosity.

Applications. The gamma log is useful in differentiating between shales and other formations.

Cased walls, or open holes with all types of fluid can be logged without difficulty with the gamma-ray tool. This makes it quite useful in correlating electric-log depths with casing-collar depths. A casing-collar log and a gamma-ray log can be correlated with an SP curve taken before the well was cased. Then the perforating tool can be run with a second collar log, locating the perforations at the exact point chosen on the electric log.

Under favorable conditions the neutron log is useful in finding gas-oil or gas-water contacts.

Velocity Logging

The velocity log measures the travel time of sound waves through subsurface formations.

Tools for this purpose are designed with an energy source, and some receivers. The number of receivers varies with the company offering the service. But the principle is generally the same. A minimum of two receivers is needed, and the quantity measured is the difference in time for the sound waves to reach the receivers.

In a tool with the first receiver located 3 ft. from the source, and a second receiver 1 ft. farther away from the source, the quantity recorded is the difference in time needed for the sound wave to reach the two receivers, or the time required for the wave to travel 1 ft.

The sound pulse finds the path that takes the least time to get from the source to the receivers. This path is the one through the fluid column in the well to the side of the hole, then down the wall to a point opposite the receiver, and then across the fluid column again to the receiver. This path, while longer than a direct path down the hole through the mud column, takes less time than any other path, and the shortest time is the one recorded.

Limitations. Velocity logs must be run in open hole only, and the hole must contain a liquid. The nature of the liquid is unimportant, as the log will work well in oil-base muds, and fresh or salty water-base muds. But the tool must be held parallel to the wall of the hole.

Log Type	Birdwell Division, Seismograph Service Corp.	Lane Wells Co.	McCullough Tool Co.	Pan Geo Atlas Corp.	Schlumberger Well Surveying Corp.	Welex, Inc.
Electrical Log	Electric Log	Electrolog	————	Electrical Log	Electrical Log	Electric Log
Induced Current Log*	————	Induction Electrolog	————	Induction-Electrical Log	Induction-Electrical Log	Induction-Electric Log
Focused Resistivity Log	Guard Log	Focused Log	————	Laterolog	Laterolog	Guard Log
Micro-Resistivity Log	Micro-Contact Log	Minilog-Caliper	————	Micro Caliper Log	Microlog-Caliper	Contact Caliper Log
Microfocused-Resistivity Log	————	Minifocused Log	————	Micro-Laterolog	Microlatero-Log	FoRxo
Radioactivity Log	Gamma Ray-Neutron Log	Gamma Ray-Neutron Log	Gamma Ray-Neutron Log	Gamma Ray-Neutron Log	Gamma Ray-Neutron Log	Gamma Ray-Neutron Log
Velocity Log	Constant Velocity Log	Acoustilog	————	Acoustical Velocity Log	Sonic Log	Acoustic Velocity Log
Density Log	————	Densilog	Density Log		Gamma Gamma Log	
Chlorine Log	————	Chlorinolog	Salinity Log	Spectral Log	Chlorine Logging	Saltilog

*Normally run along with some curves from conventional electrical log.

TRADE NAMES are sometimes confusing. To avoid this confusion in well-logging terminology, here is a table of trade names given to various types of well surveys covered in the accompanying article.

Applications. Velocity of sound, or transit time, in rock formations is a function of the nature of the rock matrix and of porosity. Therefore, the velocity log can be used to find rock porosities. And the correlation between transit time and porosity is linear.

For the geologist, the velocity log is a convenient tool for correlation. Since it is unaffected by hole size and drilling-fluid salinity there is no difficulty involved in correlating between wells drilled under different conditions in the same general area.

When short spacing is used between receivers, say 1 ft., the log easily picks up thin beds, and responds well to sharp lithologic changes. In this connection it behaves in a manner similar to a microdevice or a focused log. With wider spacing, the travel times will be averaged over a zone or zones equal in thickness to the spacing, approximately.

Density Logging

Electron density in a formation is proportional to bulk density. This principle has been applied to a fairly new development in well logging.

Density logging uses a tool that has a fairly strong gamma-ray source. Rays from the source are diffused through the formation and are counted by a scintillation counter. The ability of the formation to absorb these gamma rays depends on the density of electrons, and hence on the bulk density of the formation. The tool's response is not affected by the nature of the electrons making up the rock material, but only on their density.

Limitations. For the estimation of porosity, the data from the density log must be supplemented by information on lithology. The geologist must provide identification of the rock type so that grain density will be known, and the density of the fluid in the hole must be known or estimated. The tool is sensitive to mud-cake thickness, but correction charts are available.

The tool must always bear against the wall of the hole while being run. This is required because of the tool's sensitivity to hole size. An eccentric, spring-loaded arm keeps the tool in place against the side of the hole, and also provides a second contact so that a caliper log is obtained on the same run.

Applications. Bulk density decreases as porosity increases. Porosity can be estimated from a density log by the formula:

$$\text{Porosity, } \phi = \frac{\rho_G - \rho_B}{\rho_G - \rho_L}$$

Where:

ρ_G = grain density (from lithology)

ρ_B = bulk density (from log)

ρ_L = liquid density (estimated, or from formation sample)

The density log, used with a neutron survey, can give a quantitative estimate of gas saturation. Neutron-derived porosity in a gas zone is less than true porosity because of the scattering of hydrogen. But density log-derived porosity under the same conditions is greater than true porosity because the density of the reservoir fluid is low. Using these two curves together, with appropriate charts, a realistic figure for gas saturation can be found.

Salinity Logging

Neutron bombardment does different things for different materials. By changing the sensitivity of the receiver, different properties of the material being bombarded can be measured.

Salinity logging makes use of this phenomenon by "tuning in" the receiver to pick up those gamma rays that are emitted when neutrons collide with atoms of chlorine.

Result of this logging system is a curve that can be correlated with other logs that show porosity, and together they can detect the presence of salt water (high chlorine content) or the lack of salt-water saturation. In subsurface rocks, the absence of salt water in a porous formation means that either oil or gas must be present.

Limitations. Invasion of mud filtrate into the formation can give some false readings on the salinity log. After casing has been cemented, enough time should be allowed for the invading fluids to disperse in the formation before a salinity log is run. Length of time depends on the permeability of the formation, amount of invasion, etc.

Applications. When run with a conventional neutron porosity log, and a casing-collar log, the salinity log is useful in predicting the best location for perforations.

Because the salinity log can be run in cased holes, its application to workover operations is obvious.

Acknowledgment

The author is indebted to the following firms that supplied information used in the preparation of this article: Birdwell Division, Seismograph Service Corp., Lane Wells Co., McCullough Tool Co., Otis Engineering Corp., Pan Geo Atlas Corp., Schlumberger Well Surveying Corp., and Welex, Inc.

Now—get true resistivities from conventional electric logs

Here's a new method that will salvage many conventional electric logs, and make correct interpretation possible. Procedure described here should make the discovery of previously unrecognized reservoirs possible.

BY HUBERT GUYOD
AND JOHN A. PRANGLIN
Well Logging Consultants,
Houston

TRUE RESISTIVITY is the key to accurate electric-log interpretation.

Many conventional logs taken in favorable reservoirs have probably been interpreted as noncommercial because a true resistivity of the formation in question could not be found.

Since the introduction of the induction log a few years ago, the conventional electric log has not been run so frequently. But it is still used in many wells in the U. S. and abroad. And there are many logs in oil-company files that have not yet had proper interpretation. Another look at these might yield startling results.

For these reasons a method has been developed for determining the true resistivities of beds and, in many instances, the resistivities and extents of their invaded zones, from an electric log comprised of a 16-in. normal, a 64-in. normal, and an 18-ft. 8-in. lateral. Data needed for preparing the charts were obtained with a resistivity analog computer.[1]

Symbols used in this article are:

R_t = resistivity of the bed of interest.
R_m = mud resistivity.
R_i = invaded zone resistivity.
R_s = shale resistivity.
d = hole diameter.
D_i = diameter of the invaded zone.
e = bed thickness.

R_m, R_s, e, and d are known or can be obtained, while R_t, R_i, and D_i are unknown, and the problem is to determine them.

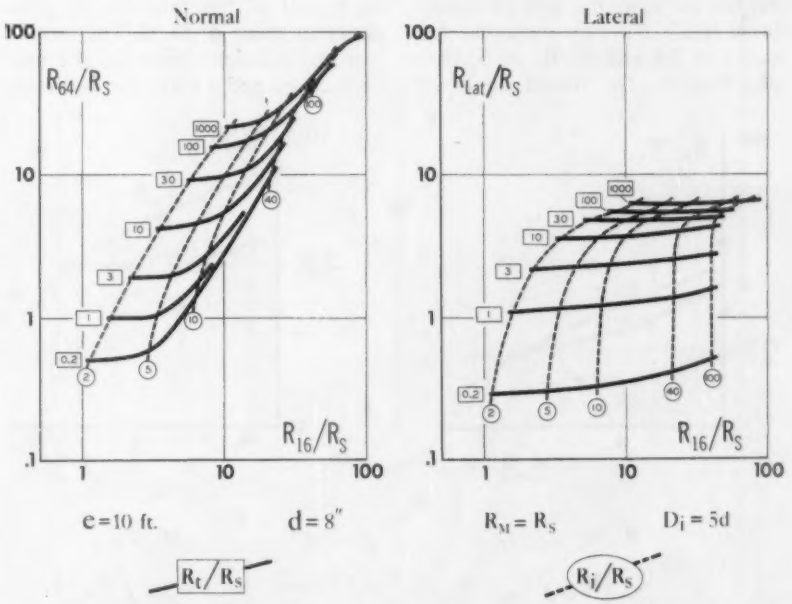
Apparent resistivities will be denoted by R_{16}, R_{64}, and R_{Lat}, respectively. For the normals, R_{16} and R_{64} are the points of the respective curves at the center of the bed, and for R_{Lat} it is either the peak value or the lowest value near the bed's lower boundary.

As usual, the basic method was developed for a single, uniform isotropic bed situated in a thick, uniform, and isotropic formation and the answers obtained are correct when these conditions are met. Actual conditions are generally different. The method still applies but the answers have to be analyzed and frequently corrected.[2,3]

The method is applicable regardless of resistivities and dimensions, whether large or small, although at present analysis charts are available only for bed resistivities that are greater than about one-tenth of R_s and for hole diameters from 5 to 12 in.

Unless specified otherwise, the following assumptions are made:

1. Bed of interest is uniform, isotropic, and situated in a very thick, uniform, and isotropic formation



PAIR OF ANALYSIS CHARTS for an 8-in. hole through a 10-ft. bed. Mud resistivity is equal to shale resistivity and the diameter of the invaded zone is five times that of the hole. Fig. 1.

called "shale" for the sake of simplification.

2. Bed is perpendicular to the bore; it has no mud cake and no low-resistivity annulus.

3. Hole diameter is 8 in.

Analysis Charts

The method is based on the use of pairs of charts, such as shown in Fig. 1. These two particular charts apply to beds 10 ft. thick, cut by an 8-in. hole, when the mud resistivity is equal to the shale resistivity, and when D_i is equal to 5d.

The chart to the left is called the normal chart: it is a plot of R_{64}/R_s in terms of R_{16}/R_s for several values and R_t/R_s and R_i/R_s. The solid, almost horizontal, lines are the R_t lines, and the figures in the squares are the corresponding R_t/R_s values. The dashed lines, which are essentially vertical, are the R_i lines, and the figures in the circles are the corresponding R_i/R_s values. For the sake of clarity only a few R_t lines are shown in the figure, although there are many more on the actual charts.

The lateral chart to the right is similar to the normal chart, except that R_{Lat}/R_s is plotted as ordinates, instead of R_{64}/R_s.

These plots are called "analysis charts." From these charts it is possible to determine the apparent resistivities that an electric log would show for any given R_t and R_i values, and for the e, d, R_m, and D_i conditions specified. For example, for $R_t/R_s = 30$ and $R_i/R_s = 5$, it is seen that R_{16}/R_s would be equal to about 10, R_{64}/R_s to 11, and R_{Lat}/R_s to 4.5.

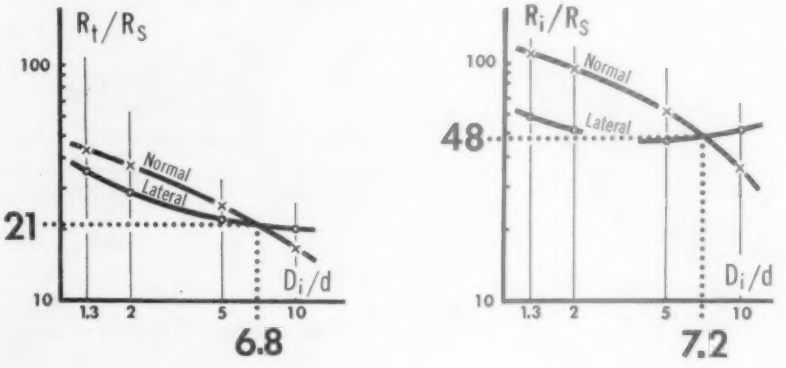
Conversely, when R_{16}, R_{64}, and R_{Lat} are given, any one of these two charts gives R_t and R_i provided e, d, R_m, and D_i are known.

In practice, e, d, and R_m are known, but D_i is not. But it is possible to determine R_t and R_i provided that pairs of analysis charts are available for a number of D_i values. In our work we have prepared charts for D_i equal to 1.3, 2, 5, and 10 times the hole diameter. With such sets of charts, the determination of R_t and R_i is done as explained below.

Principle of Method

First the analysis charts corresponding to the actual e, d, and R_m values are selected. Then it is assumed that D_i is equal to 1.3 times d—although it is known that this assumption probably is incorrect—and from the $D_i = 1.3d$ normal chart solutions for R_t/R_s and R_i/R_s are obtained. The same is done with the other normal analysis charts, i.e., those corresponding to $D_i = 2d$, 5d, and 10d, respectively. Then the procedure is repeated, using the lateral charts. Neither of these solutions is correct or if, through some coincidence, one is correct, this fact is not known.

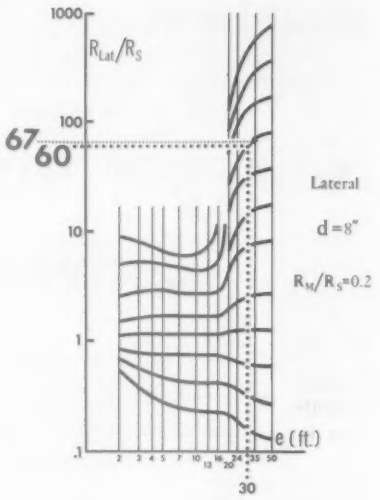
At this point a set of false solutions has been obtained, and it is used as shown in Fig. 2. To the left is a plot of the false R_t/R_s solutions in terms of D_i/d. The crosses are the solutions given by the normal charts and a curve can be drawn through them: this curve is called the normal plot. The circles represent the solutions given by the lateral charts, and the curve through them is called the lateral plot. These two curves generally intersect at a point whose abscissa is evidently equal to the actual D_i/d value, while its ordinate gives the R_t/R_s solution.



Given: $e = 10$ ft., $d = 8''$, $R_M = R_S$; $R_{16}/R_S = 38$, $R_{64}/R_S = 32$, $R_{Lat}/R_S = 4$

Solution: $R_t/R_S = 21$, $R_i/R_S = 48$, $D_i \approx 7d$

DETERMINATION of R_t/R_s, R_i/R_s, and D_i/d from R_t and R_i plots. Fig. 2.



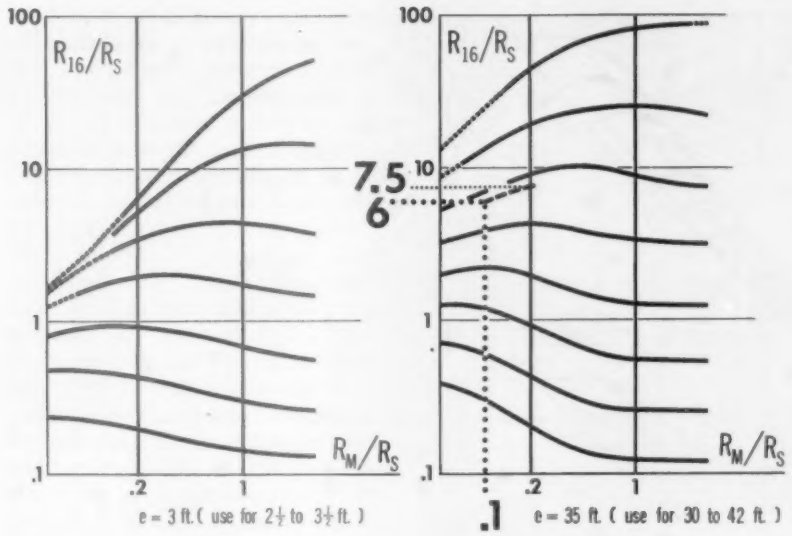
e TRANSFORMATION

EXAMPLE of e transformation. Fig. 3.

Similar normal and lateral plots are made with the false R_i/R_s solutions, as shown to the right of the figure, and the ordinate of their intersection point gives the correct R_i/R_s solution. The abscissa gives a D_i/d solution which, in theory, should be the same as that obtained from the R_t/R_s plot. In practice, lack of uniformity in the bed may give somewhat different values.

Thus we have determined R_t/R_s, R_i/R_s, and D_i/d, from which R_t, R_i, and D_i can be readily computed.

In the example given above, the solution is obtained quickly and easily because analysis charts are available for the actual e, d, and R_m values. In practice this will seldom be so because only a limited number of charts are available. We have found that good solutions can be obtained for most usual conditions with only 24 sets of charts, namely for 12 bed thicknesses, 2 mud resistivities, and 1 hole diameter, that is for 24 combinations of e, d, and R_m.[2] For each of these 24 combinations there are four normal charts: for $D_i/d = 1.3$, 2, 5, and 10. This makes a total of 96 normal charts. Of course the coun-



R_M TRANSFORMATION
16" NORMAL
d=8"

EXAMPLE of R_m transformation. Fig. 4.

terpart lateral charts are also required. This makes a total of 192 charts, a large number considering that we have only 24 combinations of e, d, and R_m.

e Transformation

Even though there are charts for 12 different bed thicknesses (from 2 to 50 ft.), interpolation is frequently required. How this interpolation is done is shown in Fig. 3. This is a chart giving the trend of R_{Lat}/R_s vs. e when R_m/R_s equals 0.2 and d equals 8 in. The vertical lines correspond to bed thicknesses for which analysis charts are directly available: 2 ft., 3 ft., 4 ft., etc., up to 50 ft. Assume that we have a 30-ft. bed and that R_{Lat}/R_s is equal to 60. The point of coordinates e = 30 and R_{Lat}/R_s = 60 is marked on the chart. From this point we follow the trend of the curves to the closest heavy vertical line, the 35-ft. line in this example. The ordinate of the point so obtained is 67. This means that, had the bed been 35 ft. thick—instead of 30—the value of R_{Lat}/R_s would have been 67. Since analysis charts for e = 35 ft. are available, we may use them, provided of course that the transformed value of R_{Lat}/R_s, i.e., 67, be used instead of the actual value, 60.

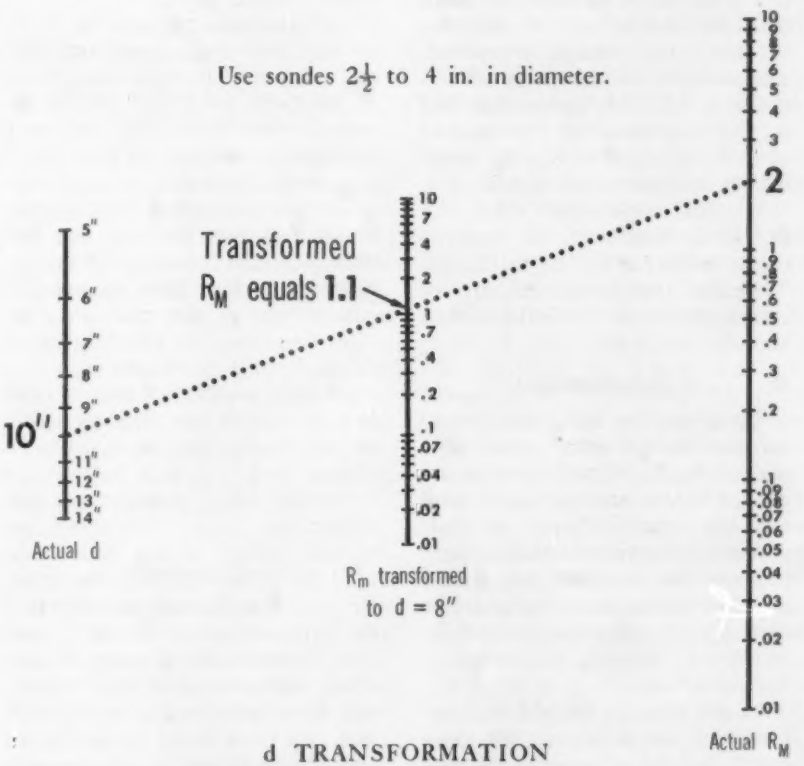
Similar transformations are needed for the short normal and for the long normal, and the corresponding charts have been prepared.

Incidently it can be seen on the transformation chart of Fig. 3 that, when the bed thickness is between about 16 and 20 ft., and when R_{Lat}/R_s is greater than 10, the apparent resistivities change tremendously when the bed thickness changes only a few inches. In this range of thicknesses it is of course illusory to make a transformation when the apparent resistivity is high. For the 64-in. normal, the counterpart critical range is 4½ to 6½ ft., approximately, and for the 16-in. normal from 0 to 1½ ft.

R_m Transformation

As previously mentioned, analysis charts have been prepared for only two mud resistivities; for R_m equal to 0.2 R_s and for R_m equal to R_s. Since R_m will generally be different from these two values, R_m transformation charts similar to those made for the bed thickness are necessary. Fig. 4 shows two of them, applicable to the 16-in. normal when the hole diameter is 8 in. They are trends of R_{16}/R_s in terms of R_m/R_s. The chart to the left is for beds about 3 ft. thick. The chart to the right is for beds 30 to 42 ft. thick. The two heavy vertical lines correspond to the mud resistivities for which analysis charts are directly available: R_m/R_s equal to 0.2 and to 1.

These R_m transformation charts are used exactly as the bed-thickness



d TRANSFORMATION

EXAMPLE of d transformation. Fig. 5.

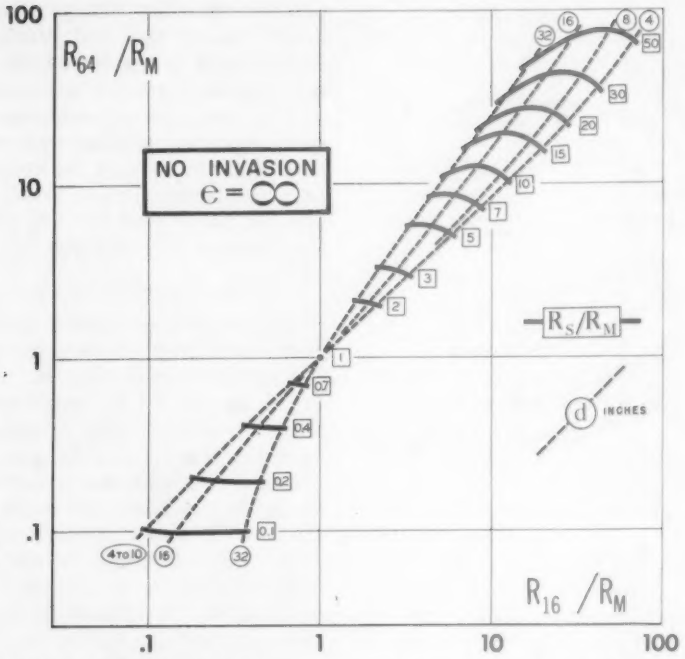


CHART FOR FINDING R_S from 16-in. and 64-in. normals in thick, non-invaded formations. Fig. 6.

transformation charts are used.

Assume for example that we have a bed 40 ft. thick for which R_{16}/R_s is equal to 6, and R_m/R_s to 0.1. We mark the corresponding point on the chart to the right and, from this point on, we follow the trend until the closest vertical line, the 0.2 line in this example, is reached. The ordinate of the point so obtained is 7.5. This means that, had R_m/R_s been equal to 0.2—instead of 0.1—the value of R_{16}/R_s would have been equal to 7.5, instead of 6. Hence this transformed value, 7.5 should be used with the analysis charts made for $R_m/R_s = 0.2$.

Similar transformations are of course needed for the 64-in. normal and for the lateral.

d Transformation

Up to now we have seen how to account for the usual values of e and of R_m/R_s. It will now be explained how to account for the third and last variable factor, the hole diameter. Analysis charts have been prepared for only one hole size, 8 in. Nevertheless these charts can be used for any diameter from 5 in. to about 12 in. provided a transformation is made.

In this case the method of transformation is different. We have found that the influence of the mud column can be expressed as a function of its conductance. This conductive ability obviously increases when the hole diameter increases or when the mud resistivity decreases, and conversely. Hence, a change in d is equivalent to a particular change in R_m.

For example, suppose we have an 8-in. hole and a mud resistivity of 1 ohm-m. If the hole diameter is doubled, the volume of mud is increased four times, and the mud conductance is increased four times. If we want the mud column to keep its original conductive effect in spite of the fact that the hole size has been increased from 8 to 16 in., we must reduce four times the specific conductivity of the mud, i.e., we must increase its resistivity four times, from 1 to 4 ohm-m.

In other words, a 4 ohm-m mud in a 16-in. hole has the same effect on the resistivity curves as a 1 ohm-m mud in an 8 in.-hole.

Actually, the principle of this equivalence is a little more involved. Instead of the square law used for d in the example given, we have found experimentally that the exponent to use is not 2, but 2.4. Further, the diameter of the sonde has to be taken into account, and the range of equivalence is limited. We have found that, after an appropriate transformation, analysis charts—or, for that matter, any type of charts—prepared for 8-in. holes may be used when actual diameter is between about 5 and 12 in. The transformation chart prepared for this purpose is shown in Fig. 5.

Suppose that the hole diameter is 10 in. and the mud resistivity 2 ohm-m. A straight line is extended through the d = 10 point of the left scale and the $R_m = 2$ point of the right scale, Fig. 5. This line intersects the center scale at 1.16. This means that, had the hole diameter been 8 in. and the mud resistivity 1.16 ohm-m—instead of 10 in. and 2 ohm-m, respectively—the apparent resistivities would have been the same, or very nearly the same. Once this transformation is done, the charts prepared for d = 8 in. may of course be used.

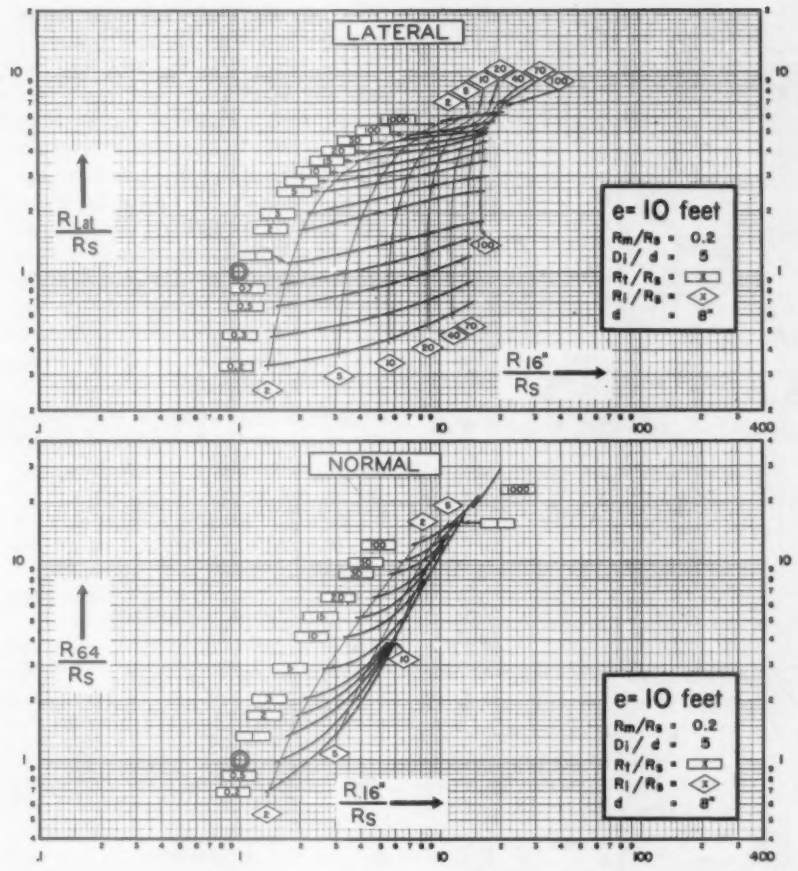
Processing Procedure

In practice the apparent resistivities are handled by a step-by-step procedure.

1. Read R_{16}, R_{64} and R_{Lat} from log.
2. Determine R_s, d, and mud resistivity. R_s can be found from conventional departure charts. However an easier method is to use the double-entry chart of Fig. 6.
3. Form R_{16}/R_s, R_{64}/R_s and R_{Lat}/R_s.
4. Transform mud resistivity to an 8 in. diameter to obtain what we call here R_m. Form R_m/R_s.
5. If R_m/R_s is not equal to 0.2 or 1, transform ratios under (3) to nearest of these two values.
6. If e is not equal to one of the values for which analysis charts are directly available, transform apparent resistivity ratios under (5) to the nearest e value.
7. Now, the apparent resistivity ratios R_{16}/R_s, R_{64}/R_s, and R_{Lat}/R_s are normalized to an 8-in. hole, to a R_m/R_s ratio of either 0.2 or 1, and to one of the 12 bed thicknesses for which analysis charts are available. Select the proper four pairs of analysis charts and process these ratios to obtain R_t/R_s, R_i/R_s, and D_i/d, from which R_t, R_i, and D_i can be computed.

R_s Determination

In the foregoing it was assumed that d, R_m, and R_s are known. The first two factors can be determined from a mud sample and a caliper log, respectively. How to obtain R_s is shown in Fig. 6. This is a plot of



PAIR OF ANALYSIS CHARTS for 10 ft. beds when mud is fairly conductive. Fig. 7.

R_{64}/R_m vs. R_{16}/R_m for very thick, noninvaded beds. The solid, essentially horizontal, lines correspond to R_s/R_m. The dash lines at 45° are the d lines. In this chart, R_{16} and R_{64} denote the average apparent resistivities in shale, given by the two normals.

R_s and, incidentally d also, can be readily determined from this chart.

Actual Cases

It has been seen that the determination of R_t, R_i, and D_i for a single, uniform bed situated in a thick, uniform shale formation is easy, whether the bed is thick or thin. The method is also applicable to certain types of nonuniform formations. For some of them, corrections are needed.[2] For others, only limiting values can be obtained. By analysis of the problem, it is possible to determine whether the solution is reasonably correct or whether it gives only average values, limiting values, or doubtful answers.

Of course there are also cases when the method fails to give a reasonable answer, for example in very broken formations.

When Either R_{64} or R_{Lat} is Not Available

There are cases when either R_{64} or R_{Lat} is not available, for instance when the bed thickness falls in one of the two critical ranges. R_t can nevertheless be determined provided R_i is known (from microresistivity, velocity, or neutron logs). Let us assume, for example, that there is no dependable R_{64} value. Make the R_t/R_s and R_i/R_s lateral plots. Determine, from the R_i/R_s plot, the D_i/d value corresponding to the known R_i. Use this D_i/d solution to determine R_t from the R_t/R_s plot.

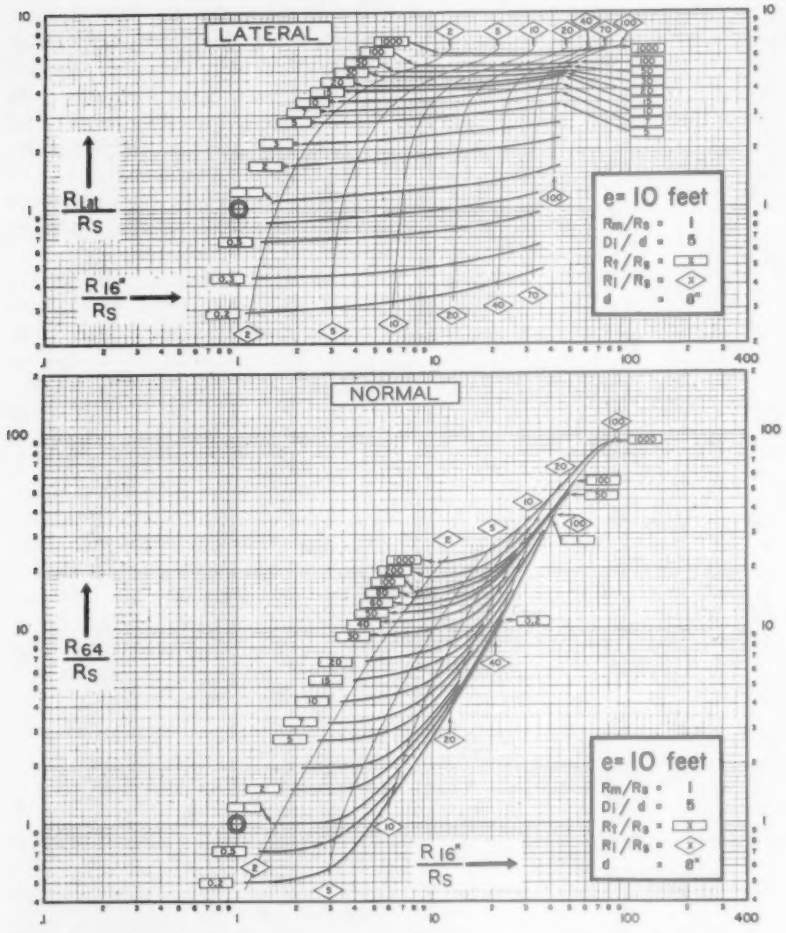
Resolving Power

The analysis and transformation charts permit also to estimate the resolving power of normals and laterals. Fig. 7 is an actual pair of analysis charts for 10-ft. beds when the mud is fairly conductive—R_m equals $0.2R_s$—and when D_i/d is equal to 5. There is a good separation between the R_t lines on the lateral chart when R_t/R_s is less than about 20 or 30. Therefore, the resolving power of the lateral is good in this range, even though the bed is relatively thin and mud conductive. On the other hand, for very resistive beds the R_t lines are much more crowded and the resolving power is therefore poor.

The normal chart shows that the resolving power of the 64-in. normal is generally good when R_i/R_s is less than about 5, i.e. for formation factors R_i/R_m less than 25. For higher values, the R_t lines converge and it is not possible in practice to determine R_t accurately, especially for very resistive beds. This rather poor performance of the normal for resistive beds is due, to a great degree, to the fact that the mud is fairly conductive.

As can be expected, the resolving power increases when the mud resistivity increases, as can be seen by comparing Figs. 7 and 8. These figures are for identical conditions, except that in Fig. 8 the mud is five times less conductive than in Fig. 7. The separation between the R_t lines is greater in Fig. 8 than in Fig. 7: the resolving power of the 64-in. normal is good even for high bed resistivities, except for those having, at the same time, a high formation factor.

We should not be too concerned by the poor results given by the 64-in. normal when formation factors are high because, when fictitious R_t/R_s solutions are plotted in terms of D_i/d, very frequently the lateral plot is nearly horizontal so that a good R_t solution is obtained from the lateral data alone. This can be verified in Fig. 9, which gives R_t and R_i plots for a particular bed 10 ft. thick for which R_m/R_s is equal to 0.2. Processing the apparent resistivities as previously explained, it is found that the normal analysis charts give upper and lower limits for $D_i/d = 1.3$ and 2, only one limit for $D_i/d = 5$, and no solution for $D_i/d = 10$. All that can be said from the normal plot alone is that R_t is somewhere within the cross hatched area. On the other hand, sharp solutions are obtained from the lateral charts. Further, the R_t lateral plot is nearly horizontal, and its average ordinate gives the R_t/R_s solution in spite of the fact that there is no intercept with the



PAIR OF ANALYSIS CHARTS for same conditions as in Fig. 7 except that mud is less conductive. Fig. 8.

normal plot. The R_i lateral plot on the right side shows that R_i/R_s is probably greater than 18. Inasmuch as R_s is equal to 5 R_m, the formation factor R_i/R_m is thus found to be greater than 90. In this example it is of course impossible to estimate D_i.

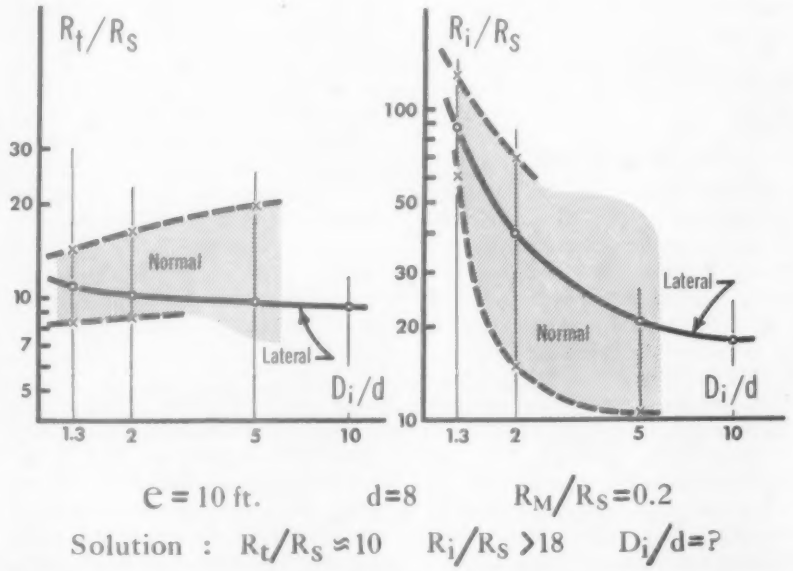
Accuracy of Solutions

The anaylsis charts show also by inspection to what extent an error made on the apparent resistivities will affect the R_t and R_i solutions. For example it can be seen on Fig. 8 that where the R_t lines of the analysis charts are nearly horizontal an error, even large, on R_{16} results in only a negligible error on the R_t solution. On the other hand since, in this case, the R_i lines are generally essentially vertical, the error on R_{16} results in an appreciable error on R_i, especially if the R_i lines are close together.

Errors on R_t caused by erroneous R_{64} and/or R_{Lat} values are relatively larger than those caused by erroneous R_{16} values since the R_t lines are essentially horizontal, but errors on the R_i are generally smaller since the R_i lines are essentially vertical.

From the density of the R_t lines it is possible to evaluate the resulting error on the R_t solution: the closer the lines, the larger the error. For certain conditions the R_t lines for very high R_t/R_s values are so crowded that it is illusory to expect to determine R_t accurately in the corresponding range of resistivities.

Using either the analysis charts or the transformation charts, similar evaluations can be made to estimate the effect on the solutions of errors made on R_s, R_m, e and d. It is thus found that errors on R_s, on R_m, or on d, affect more the accuracy of the R_i solutions than that of the R_t solutions.



EXAMPLE of R_t/R_s determination from lateral plot alone. Dash lines represent upper and lower limits for solutions given by normal analysis charts. Fig. 9.

Acknowledgment

Grateful acknowledgment is made to PGAC for a grant-in-aid to assist in the preparation of the analysis charts. Also to Atlantic Refining Co., California Research Corp., Mobil Oil Co., Pan American Petroleum corp., Shell Oil Co., and Sohio Petroleum Co. whose assistance permitted the design and construction of the resistivity analog computer used for the calculations.

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2. Guyod, H. and Pranglin, J. A. "Analysis Charts for the Determination of True Resistivity From Electric Logs": publ. by H. Guyod, 1959.
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When the borehole contains only a gas, specialized logging methods are needed to get quantitative information on porosity and saturation. Here are some recommended programs that will give results in . . .

LOGGING EMPTY HOLES

BY C. G. RODERMUND, R. P. ALGER, AND J. TITTMAN
Schlumberger Well Surveying Corporatoin

POROSITY AND SATURATION, reduced to numbers, are what operators are looking for these days.

And more and more wells are being drilled with air or gas.

Put these two things together, and you have some new logging problems to cope with. When a well is drilled with a liquid, conventional resistivity-measuring tools can be used with good results. But with an empty hole, conditions are different, and new methods must be used.

The recent development of the density logging tool (Schlumberger's Gamma-Gamma Density Log) made it possible to prepare logging programs to suit all conditions involving wells drilled with air or gas.

Examples that follow are based on experience with cable-tool wells around Ohio and West Virginia, but the empty-hole programs can be applied to wells drilled with rotary tools, as long as other conditions are met.

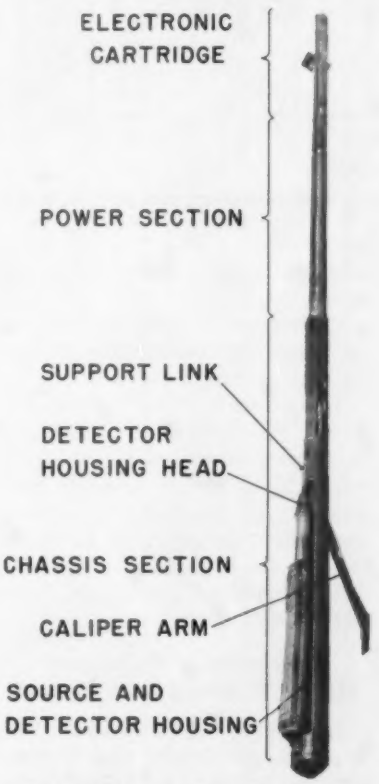
Basic Logging Tools

The interpretation program for empty holes uses three basic logging tools: induction, neutron, and density logs.

Induction. The induction log is the only device capable of measuring resistivity in an empty borehole, and this condition enhances its ability to obtain R_t.

Neutron. The neutron log has long been the logging industry's only approach to the determination of porosity in empty boreholes. Under these conditions, log interpretation is usually done by an empirical scaling method. For the subsequent neutron-log study, a logarithmic porosity scale is applied between two control points. The shale deflection is used as 35% porosity, and a 2% porosity point is determined by the maximum neutron deflection in a dense carbonate. Gas-bearing carbonates may produce even larger deflections, but the density log will distinguish these from the dense zones.

Paper presented at second annual meeting of Society of Professional Well Log Analysts, Dallas, May 17-19, 1961.

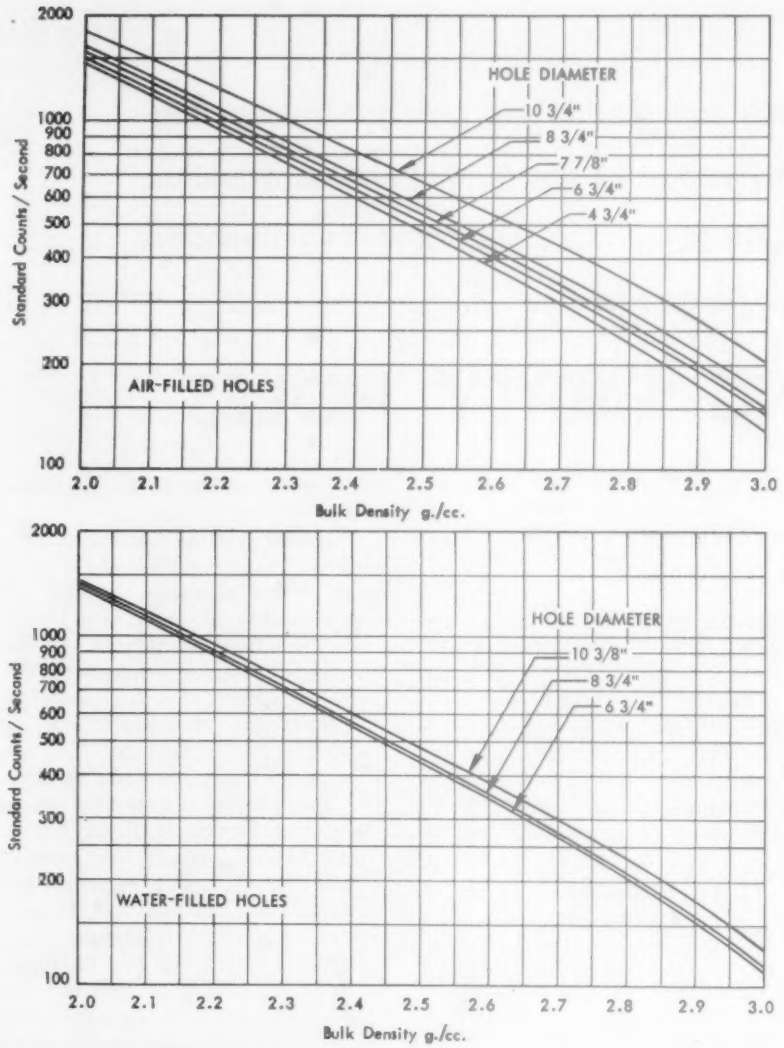


BULK DENSITY is measured with this Schlumberger Gamma-Gamma sonde. Fig. 1.

Density. The Schlumberger Gamma-Gamma sonde (Fig. 1) is a device which measures, in situ, the bulk density of subsurface formations penetrated by a borehole. The name indicates the principle of operation: gamma rays are emitted by a source and, after having diffused through the formations, they are counted by a gamma-ray detector.

The principle is somewhat similar to that of the neutron sonde, but the big difference between the two tools is in the manner in which the emitted gamma rays and the neutrons interact with the formations. In neutron logging, the important effects are caused by collisions between the neutrons and hydrogen atoms. Gamma rays, on the other hand, interact with the electrons which are always present in each atom of formation. The density logging tool has been so designed that its response depends upon the electron density (electrons per cc.) in the formation, and not upon the nature of the atoms. This electron density is almost exactly proportional to the bulk density of the formation.

Fig. 2 shows how the counting rate varies with bulk density of the formation. Note that for the density-logging tool, the counting rate is approximately an exponential function of the bulk density. This means that the device has a constant density resolution irrespective of the value. Thus the fractional change in counting rate for a density change of 1 g/cc. is the same, whether the density is high or low. This property persists with respect to porosity, also.



COUNTING RATE varies with bulk density of a rock formation, and with hole size as shown here. Fig. 2.

Associated Services

Gamma Ray. The gamma-ray log is used as the correlation device in each of the described methods. It also provides an indication of the accuracy of the interpretation since shaliness is always detrimental to any analysis. The neutron is quickly affected as shaliness increases, whereas the effect of shaliness on the density log is usually small and frequently unobservable.

Caliper. The density tool must make good contact with the wall of the hole. If, due to hole roughness or caving, there is gas between the articulated skid and the formation, the sonde will average it in and the apparent density will appear much too low. Therefore, a caliper log is essential to avoid errors in interpretation; preferably, it should be recorded simultaneously with the density log.

Knowledge of hole diameter is also needed for interpreting neutron and temperature surveys.

Temperature. The temperature survey is valuable for confirming low-density anomalies in that it pinpoints zones having sufficient permeability to produce gas without stimulation treatment. In favorable cases it can be used to determine the proportional production from two or more zones.[1]

Interpretation Techniques
Density-Hydrogen Index Method

Density tool response. The Schlumberger density tool is presently calibrated to read directly the bulk density of the formation. With the procurement of the bulk density, ρ_B, the role of the sonde is terminated. The interpretation procedure for porosity now depends on the introduction of correct grain and fluid densities. The bulk density is an average of the densities of the solids and the densities of the fluids contained in the pore spaces.

Consider a unit volume of formation, where the porosity, ϕ, is filled with fluids having a density of ρ_F. The remaining volume, 1-ϕ, represents the rock matrix whose grain density is ρ_G. Bulk density is then given by:

$$\rho_B = \phi\rho_F + (1 - \phi)\,\rho_G \qquad (1)$$

Solving for ϕ, we have:

$$\phi = \frac{\rho_G - \rho_B}{\rho_G - \rho_F} \qquad (2)$$

It can be seen that a quantitative porosity can now be derived with the knowledge of three parameters. Values for ρ_B are taken directly from the density log. Usually ρ_G can be obtained with sufficient accuracy from some prior knowledge of the type of formation being analyzed in empty-hole logging. ρ_F cannot be assumed as readily. Depending on the gas-to-liquid ratio, ρ_F will be either the average density of the liquids in the pore space or something less. If, for example, we have 70% liquid saturation with gas in the remainder of the pore space, ρ_F would be:

$$\rho_F = S_L\rho_L + S_g\rho_g \qquad (3)$$

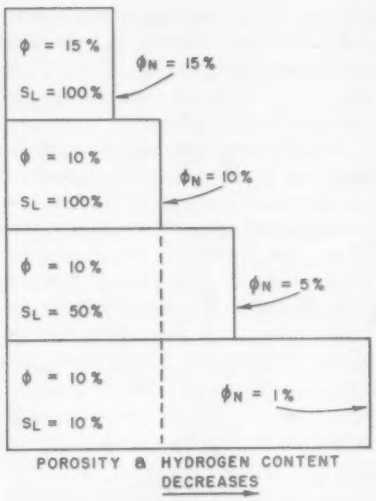
(where S_L and S_g are the liquid and gas saturations, respectively)

then,

$$\rho_F = 0.7\rho_L + 0.3\rho_G$$

Density of formation water ranges from 0.95 g./cc. to 1.10 g./cc. approximately depending on temperature, pressure, and salinity. Average density of oil is slightly lower than these values and varies over an equally wide range. A simple calculation shows that errors due to these variations are negligible. Therefore, for simplicity and practical reasons, we use a value of unity for the term ρ_L. The gas density, ρ_g, for reservoirs producing gas into an empty hole approaches 0 g./cc. It follows then that

$$\rho_F = 0.7 \times 1 + 0.3 \times 0 = 0.7\ \text{g./cc.}$$



NEUTRON-DERIVED POROSITY approaches true porosity as liquid saturation approaches 100%. But as liquid saturation falls off, the hydrogen index decreases. Fig. 3.

In this special case, where the gas density is zero and the liquid density is unity, we always have the same interesting result:

$$\rho_F = S_L \qquad (4)$$

In any case, to determine the gas-to-liquid ratio it is necessary to have further information, which either the neutron or the induction log will supply.

Neutron response. The neutron logging device is primarily sensitive to the hydrogen content of the formation. Since in shale-free rocks the hydrogen present is generally in the form of the fluids in the pore space, it follows that as porosity varies, the hydrogen content of the formation will vary. The log is calibrated to read true porosity when the pore space is 100% liquid filled. Since oil and water have approximately the same hydrogen content per unit volume, the water-to-oil ratio makes no difference in the response to the tool. Difficulty arises when gas is also present. Since the gas occupies volume, but has both a very low hydrogen index and a low density, it alters the usual interpretation of both the density and neutron logs. As gas saturation increases, hydrogen content necessarily decreases and the hydrogen index, as given by the neutron log, decreases. In Fig. 3, zones A and B, both with 100% S_L, show 15% and 10% porosity, respectively. In these instances, the hydrogen index is the true porosity of each zone. Zones C and D indicate 10% porosity, but with a reduction in liquid saturation to 50% and then to 10%. It can be seen that as S_L approaches 100%, the hydrogen index (ϕ_N) approaches the true porosity. This relationship, in equation form, is:

$$S_L = \phi_N/\phi \qquad (5)$$

As explained previously, in a zone having $0.7 = S_L$ the ρ_F was also 0.7. Since we saw that $S_L = \rho_F$ in Equation 4 and since $S_L = \phi_N/\phi$, we can make a substitution in Equation 2 so that:

$$\phi = \frac{\rho_G - \rho_B}{\rho_G - (\phi_N/\phi)} \qquad (6A)$$

Solving for ϕ:

$$\phi = \frac{\rho_G - \rho_B + \phi_N}{\rho_G} \qquad (6B)$$

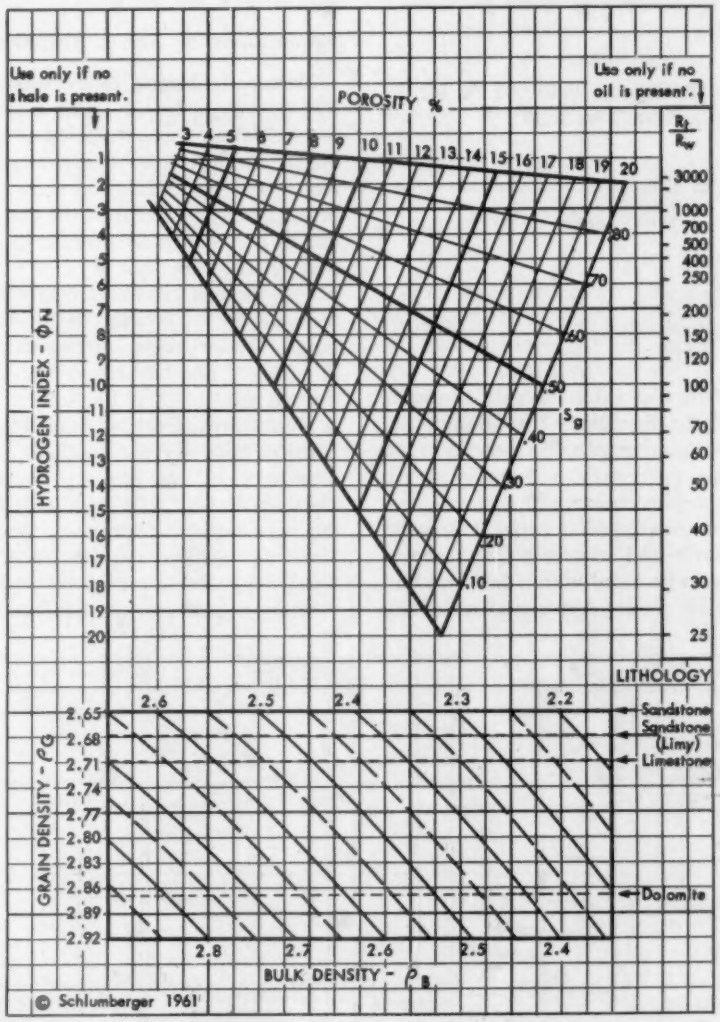
With this value of ϕ we can refer back to Equation 5 to obtain S_L.

It is now apparent that from data supplied by the density and neutron logs we can arrive at quantitative porosity and liquid saturation. This process is solved graphically by use of the chart shown on Fig. 4. By plotting ρ_B against ϕ_N, using the appropriate value of ρ_G, ϕ and S_g are read directly from the body of the chart.

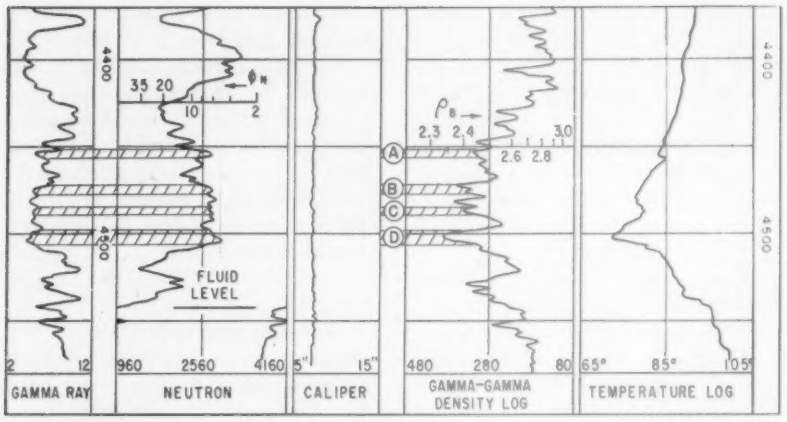
Density, resistivity method. Another approach is possible when appropriate reservoir conditions exist; i.e., when water is the only liquid present in the pore space. Instead of Equation 5, a variation of the Archie relationship for S_w can be used.

$$S_w = (1/\phi)\sqrt{R_w/R_t} \qquad (7)$$

In this relationship we need R_t



DENSITY AND NEUTRON log data can be used with this chart to find porosity and liquid saturation. Fig. 4.



EXAMPLE 1—Application of the density-hydrogen index program.

and R_w information. R_w must be obtained from some prior knowledge of the area. R_t can be obtained quite accurately and with little correction from the induction log. When the only liquid present is water, we can see from Equation 4 that

$$\rho_F = S_w \qquad (8)$$

Substituting the value of S_w for ρ_F in Equation 2 we have:

$$\phi = \frac{\rho_G - \rho_B}{\rho_G - (1/\phi)\sqrt{R_w/R_t}} \qquad (9A)$$

Solving for ϕ:

$$\phi = \frac{\rho_G - \rho_B + \sqrt{R_w/R_t}}{\rho_G} \qquad (9B)$$

With this value of ϕ we can refer back to Equation 7 to obtain S_w. We should emphasize that Equation 9B is valid only if there is no oil in the pore space.

In some special cases it may be possible and advisable for the borehole to be filled with a few hundred feet of water. A focused resistivity log may then be used instead of the induction log. It gives better resistivity definition in thin beds and in highly resistive zones. Fig. 4 is also used to solve Equation 9. By plotting R_t/R_w versus ρ_B and ρ_G, ϕ and S_g data are obtained.

Applications of Above Techniques

Density-hydrogen index method. The density-hydrogen index method is used where gas saturation is primarily the information desired. Porosity and gas saturation data can be obtained regardless of the combination of the liquids present in the pore space.

This method has limitations where the neutron log is affected by shaliness. Under these circumstances the derived porosity is too high and the gas saturation is too low.

Density-resistivity method. In the density-resistivity method, gas saturation is still of primary interest. Here, however, it is required that the pore liquid be formation water. Since this method requires accurate resistivity values, use of the induction log is suitable when $R_t < 200$ ohm-m. If higher resistivities occur, a focused resistivity log may be used after spotting water in the hole. The effects of shaliness are less important with this method.

Density-hydrogen index-resistivity method. If a fractional analysis of all the fluids present is needed, it is necessary to provide R_t information from the induction or resistivity tools. With the true porosity obtainable through the density-hydrogen index plot, the use of R_t/R_w in Archie's Equation 7 will then provide S_w. Since we already have S_g, and now S_w, the S_o may be computed ($S_o = 1 - S_g - S_w$).

Examples

Density-hydrogen index method. Example I is of a Clinton sandstone from a well in Ohio. In zone A the bulk density from the log is 2.44 g./cc. The neutron-derived index is 6%. On the basis of core analysis, the grain density of this sandstone has been found to be 2.68 g./cc.

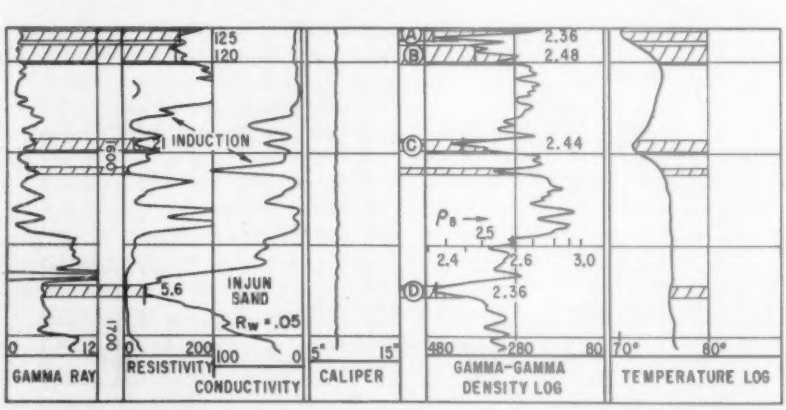
Enter the bottom of the chart (Fig. 4) with the bulk density (2.44); proceed diagonally to the appropriate grain density (2.68). Move vertically to plot this point against the neutron index (6%). This location is at the intersection of the true porosity (11%) and the gas saturation (0.47) of this zone. Note that 53% of the fluids in the pore space are unaccounted for. Since this was primarily a gas field, even though some oil is produced, knowledge of oil saturation was not considered important. In any case, the gas saturation determination is independent of the amount of oil which may be present.

A summary of the interpretation of this formation is shown below:

Zone	ρ_G	ρ_B	ϕ_N	ϕ	S_g
A	2.68	2.44	6.0%	11.0%	0.47
B	....	2.41	6.0	12.3	0.52
C	....	2.40	6.0	12.5	0.53
D	....	2.34	4.5	14.0	0.68

On final completion this well had an open flow potential of 4 M.M.c.f.d.

Density - resistivity method. Example 2 shows logs from a well in West Virginia in a region where gas production is sometimes found in the base of the Big lime and in the Injun sandstone immediately below. The logs available are gamma ray, density, induction, and temperature.



EXAMPLE 2—Application of the density-resistivity program.

Thus, the density-resistivity method may be used.

The grain density used in the Big lime is 2.75 g./cc. In zone A the bulk density is 2.36 g./cc. and R_t from the induction log is 125 ohm-m. R_w in this area is known to be 0.05 ohm-m, so that R_t/R_w becomes 2,500. The procedure is to enter the chart with the bulk density (2.36) then proceed diagonally to the proper grain density (2.75). This locates the abscissa value to plot against the ordinate value of R_t/R_w (2,500). The plotted point indicates a true porosity of 14.8% and a gas saturation of 0.87. We again point out that this system is applicable only if no oil is present in the pore space.

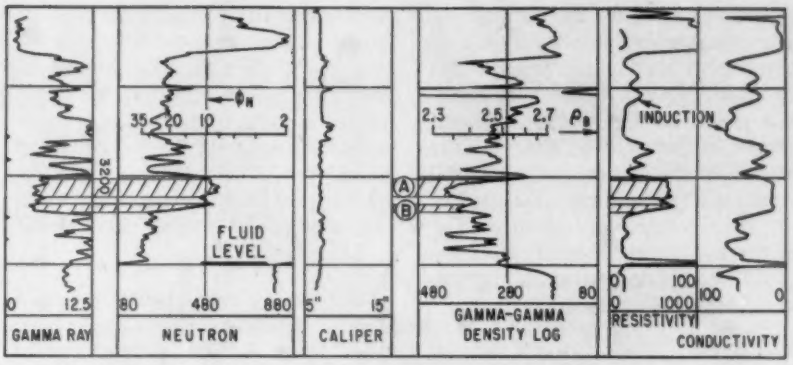
A summary of the interpretation of these logs is shown below:

Zone	ρ_G	ρ_B	R_t	R_w	R_t/R_w	ϕ	S_g
A	2.75	2.36	125.0	0.05	2,500	14.8	0.87
B	....	2.48	120.0	....	2,440	10.4	0.80
C	....	2.44	21.0	....	420	13.0	0.62
D	2.68	2.36	5.6	....	112	15.3	0.40

In this case the induction log helps select between two possible interpretations of the density and temperature surveys. For example, zone D could be impermeable, gas-filled beds, or high porosity, liquid-filled formations. The induction log by virtue of the small R_t reading indicates the latter condition. Actual production tests yielded large quantities of water plus a small amount of gas from zone D. Zones A, B, and C will become good producers.

Density-hydrogen index-resistivity method. Example 3 shows logs recorded through the Clinton sandstone. Included are gamma ray, density, neutron, and induction logs. These were run to achieve a complete analysis of all the fluids present.

In zone A, the bulk density is 2.34 g./cc. and the grain density is 2.68 g./cc. The neutron index is 8.0%. R_t is 68 ohm-m, and R_w is 0.04 ohm-m. Using the density and neutron data on Fig. 4, we get a true porosity of 15.5% and a gas saturation of 0.48. To distinguish between the two fluids, water and oil, we will use the derived true porosity (15.5%) together with the known R_w and the R_t from the induction log. Archie's Equation 7 gives water saturation (S_w) of 0.14.



EXAMPLE 3—Application of the density-hydrogen index-resistivity program.

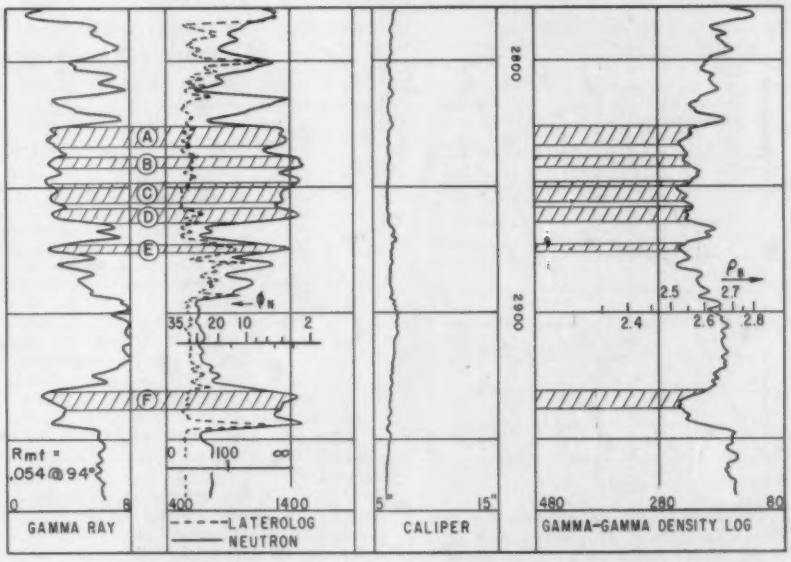
Oil saturation is then (1.00 − 0.48 − 0.14) or 0.38. Since there is oil in the pore space, we cannot enter Fig. 4 with R_t/R_w.

A summary of the interpretation of these logs is shown below:

Zone	ρ_G	ρ_B	ϕ_N	ϕ	S_g	R_t	R_w	S_w	S_o
A	2.68	2.34	8.0	15.5	0.48	68	0.04	0.14	0.38
B	2.68	2.36	9.0	15.0	0.44	70	0.04	0.14	0.42

Completion results for these zones show that 350,000 cu. ft. of gas per day is being delivered into the pipeline. The formation (or rock) pressure is reported as 800 psi. A small amount of oil is also produced.

Example 4 shows logs of the Clinton sand in Ohio. This is a case of particular interest because it uses the focused resistivity log instead of the induction log. In this instance, a slight amount of water was being produced from a formation above the Clinton. At the time the logs were run, the hole contained approximately 1,000 ft. of salt water. Since gas was being produced to the atmosphere, no invasion had occurred. The gas density in the reservoir is still sufficiently low to allow the use of these techniques. Another point of interest is that most of the sands in this well have only gas and water present. This gives us an opportunity to use both the density-hydrogen index and density-resistivity



EXAMPLE 4—Program for water-loaded holes producing gas.

techniques on the same formations. The data have been tabulated in chart form so that comparison can be made. Note that these two methods give remarkably similar results except in the case of zone E. The logs show the presence of oil in this zone, which precludes the use of the density-resistivity method. Use of the two approaches to saturation could be said to provide a "saturation balance" technique.

Zone	ρ_G	ρ_B	R_t	R_w	R_t/R_w	ϕ_N
A	2.68	2.54	38	0.04	950	3.5
B	....	2.54	45	...	1,125	2.5
C	....	2.53	28	...	700	3.5
D	....	2.55	48	...	1,200	2.5
E	....	2.53	120	...	3,000	3.0
F	....	2.53	35	...	875	3.5

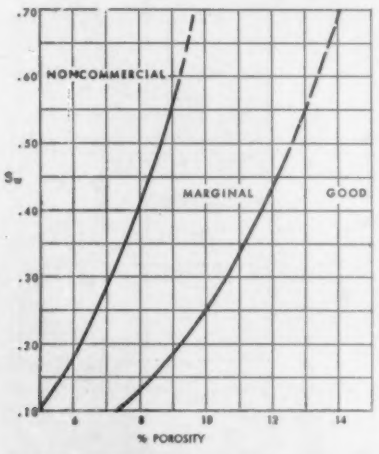
Zone—	A		B		C		D		E		F	
Method—	ϕ	S_g	ϕ	S_g	ϕ	S_g	ϕ	S_g	ϕ	S_g	ϕ	S_g
Density-hydrogen index	6.5	0.45	6.1	0.59	6.9	0.49	5.8	0.56	6.7	0.55	6.9	0.49
Density-resistivity	6.5	0.49	6.3	0.51	7.0	0.43	6.0	0.50	6.2	0.72	6.9	0.50

Completion attempts yielded a small amount of water with a show of gas.

Use of Quantitative Data

When the appropriate conditions prevail, the values obtained for porosity and saturation permit computation of the reservoir fluids in place. For gas wells, the additional information such as temperature and rock pressure allows an estimation of producible reserves.

Another important application of quantitative data concerning porosity and water saturation is the estimation of the reservoir's ability to produce. Experience in the Clinton sandstone, for example, was used to construct Fig. 5. Here it is clearly seen that porosity information alone will not properly predict the productivity. A necessary condition for the use of Fig. 5 is the existence of irreducible water saturation; this situation, in fact, occurs in the Clinton sandstone. Similar charts could be made for other sandstones, or regions, provided that such gas zones are at irreducible water saturation.



GAS-PRODUCTIVITY estimation for the Clinton sandstone. This chart was prepared from experience with several Clinton completions. Fig. 5.

Conclusions

An empty-hole logging program for the fractional analysis of reservoir fluids lacked a fundamental porosity tool until the advent of the density device. Now, by combining the bulk density of the formation with the hydrogen index, or with the true resistivity, the true porosity and fractional fluid saturations may be computed.

The accompanying table summarizes the proper conditions for log selection and the corresponding interpretation methods. Note that the neutron log and induction log are somewhat interchangable, particularly when gas is the only hydrocarbon present. In general, the induction log is preferable, since the neutron log is bothered by shaliness, and the hydrogen-index calibration is sometimes difficult. On the other hand, the density log is practically unaffected by shaliness, is readily calibrated, and works as well in empty as in mud-filled holes. It has, in fact, shown itself to be the key to all interpretations in empty-hole logging.

Symbols

1. Saturation terms, as fractions of pore space
   S_w = water saturation
   S_g = gas saturation (equals $1 - S_w - S_o$)
   S_o = oil saturation (equals $1 - S_w - S_g$)
   S_L = liquid (oil + water) (equals $1 - S_w$)
2. Density terms, given in g./cc.
   ρ_G = grain density of matrix
   ρ_B = bulk density; obtained from Gamma-Gamma Density Log
   ρ_L = liquid density, includes oil and water
   ρ_g = gas density
   ρ_F = average fluid density, includes water, oil, and gas
3. Porosity terms
   ϕ = True porosity of the formation
   ϕ_N = Hydrogen Index, as derived from neutron
4. Resistivity terms
   R_t = true resistivity of the formation
   R_w = resistivity of the formation water

Acknowledgments

The authors acknowledge the notable contribution of John S. Wahl to the design of the Schlumberger Gamma-Gamma Density sonde and to the development of interpretation methods for its logs. They also are indebted to W. E. Bachman and J. A. McGuire whose enthusiasm and technical ability helped develop and refine the field application of these logging programs. The authors are most grateful to the producing companies which have released the examples used as illustrations for this paper.

Reference

1. Kunz, K. S., and Tixier, M. P., "Temperature Surveys in Gas-Producing Wells": Petr. Tech., vol. 205, p. 111 f. (1955).

SUMMARY OF EMPTY-HOLE LOGGING PROGRAMS

Basic Logs	Hole Conditions	Formation Fluids	Interpretation Results	Remarks
Density plus Neutron	Empty, smooth	Gas + oil and/or water	ϕ, S_g (by chart)	Requires shale-free formations.
Density plus induction*	Empty, smooth and $R_t < 200$	(1) Gas + water (2) Oil + water	ϕ, S_g (by chart) ϕ, S_w (by Archie)	R_w must be known. Moderate shaliness tolerated.
Density plus neutron plus induction*	As above	Gas + oil + water	ϕ, S_g, S_o, S_w (by chart and Archie)	R_w must be known. Requires shale-free formation.
Auxiliary Logs:	Gamma ray and caliper are essential; temperature is very helpful.			

*Induction log may be replaced by a focused resistivity log if the hole is properly water-loaded. Water loading implies that a cable-tool hole or an air-drilled hole became partially filled with water: (a) Due to natural production of formation water, (b) Because water was spotted to partially control gas flow, (c) Because water was spotted to enable running a focused resistivity log, which is effective in highly resistive and/or thin beds.

WHATTA YA' MEAN— SIMPLIFIED?

INDUCTION
GUARD
NEUTRON
FoRxo
ACOUSTIC VELOCITY

Welex Simplified Program—More Answers With Fewer Logs

That's right—Simplified!

The new Simplified Logging Program, available only from Welex, gives the best, most accurate answers available in all of today's wells. It cuts costs, confusion and complicated computations to a minimum.

The program is designed to place routine log interpretation and calculations in the hands of the field geologist and engineer. Even for more complex conditions, the Welex program gives the expert log analyst the fastest, most accurate values to use in log interpretation.

Welex's Simplified Logging Program offers two primary advantages:

First: Choice of the RIGHT logging services is made simple—and without risk of running too many logs or too few.

Second: Reading porosity values and other values used in calculating fluid saturation directly off the logs is simplified, making actual determination of these two factors simple and fast.

The new simplified Interpretation Charts or "pigtails" now mean that many wells can be accurately evaluated in minutes after the log is run. To get the values necessary to work the charts, two steps should be followed:

1. Select the proper resistivity log to answer the question: what is the FLUID SATURATION in the zone of interest? Based on salinity contrast between drilling mud and formation water, this choice will be either the Induction Log or Guard Log.

2. Select the proper log based on the question—what type is the POROSITY in the zone of interest? This choice—either the FoRxo, Acoustic Velocity or Neutron Log—is based on whether the porosity of the formation is intergranular or fractured or vuggy.

Only the two questions listed above—POROSITY and FLUID SATURATION—must be answered to determine if oil or gas is present in the well.

Selection of the Right Logging Service

In order to select the right logging combination for a well, the operator determines two factors:

First, is the salinity contrast high or low?

Basically when the salinity contrast is low, the best choice is the Guard Log. When the contrast is high and for oil base muds and air or gas drilled holes, the best choice is the Induction Log.

Second, what type of porosity is present in the zone of interest—intergranular or fractured and/or vuggy?

Figure 1 makes the selection simple, based on these two factors.

One of the primary advantages of Welex's Simplified Logging Program is that each of the five logs records the basic measurement with a single curve, making it possible to read the values directly off the log without corrections and computations.

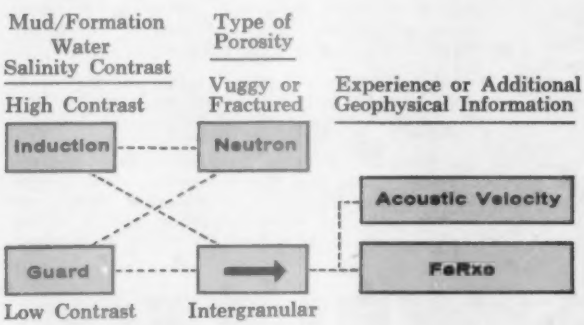


Figure 1

Fluid Saturation . . .

INDUCTION, GUARD OR INDUCTION W/LONG LATERAL?

Determination of the FLUID SATURATION in the well is based on the values read directly off the Induction Log or Guard Log. Selection of the correct log is based on the salinity contrast between drilling mud and formation water. This easily understood concept is best described and measured in terms of a resistivity ratio.

Accurate determination of this ratio, which can be obtained from known data in the area or from the SP, is very important. Designated as the Rmf/Rw ratio (resistivity of mud filtrate/resistivity of formation water), this contrast governs the choice of the logging tool to determine the formation's true resistivity (Rt) because it controls the Rxo/Ro ratio (resistivity of the first few inches completely flushed by mud filtrate/resistivity of the formation completely saturated with formation water).

Generally, the Guard tool is affected mostly by higher resistivity, either invaded zone or Rt; and the Induction tool is affected mostly by lower resistivity, whether invaded zone or Rt. Each tool records resistivity values with a single curve.

Figure 2 shows the area of application of each of these two tools, depending on the Rmf/Rw ratios (SP values may be used as an alternate method of making this determination).

The Guard Log is more accurate in the area where the static SP is 50 to 55 millivolts or less (negative deflection

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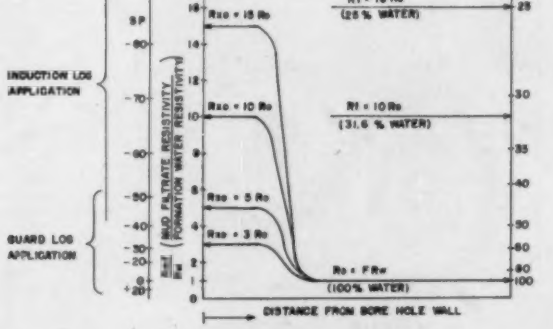
RXO (FRmf)
Rt
SP
Rxo = 15 Ro
Rt = 15 Ro (25 % WATER)
Rxo = 10 Ro
Rt = 10 Ro (31.6 % WATER)
Rxo = 5 Ro
Rxo = 3 Ro
Ro = FRw (100% WATER)
INDUCTION LOG APPLICATION
GUARD LOG APPLICATION
Rmf/Rw (MUD FILTRATE RESISTIVITY / FORMATION WATER RESISTIVITY)
DISTANCE FROM BORE HOLE WALL

Figure 2

(Advertisement)

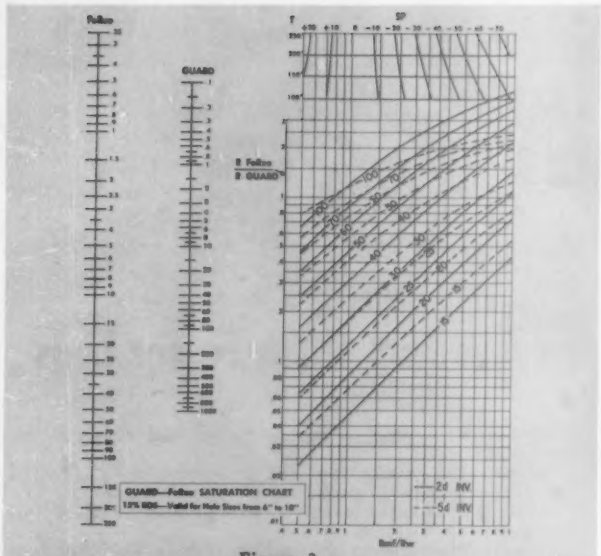

Figure 3

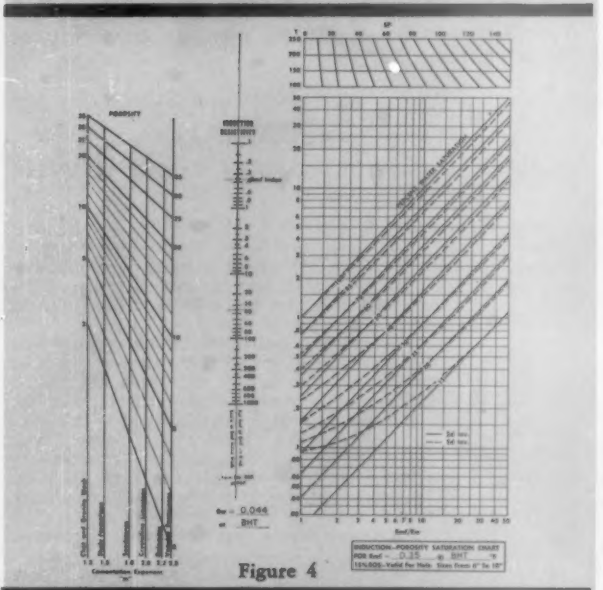

Figure 4

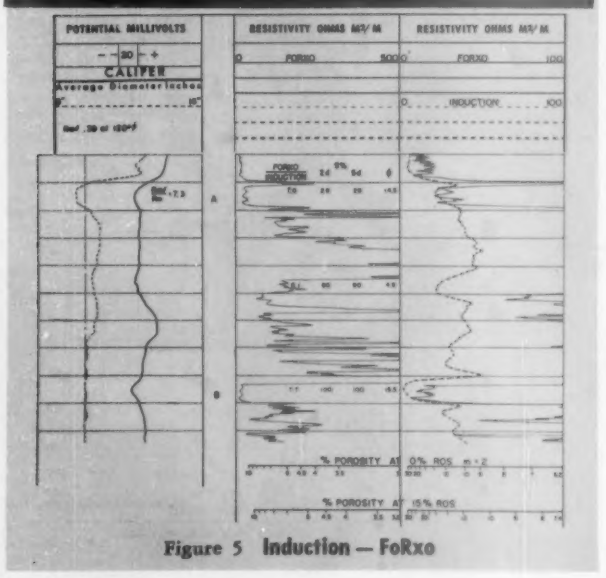

Figure 5 Induction — FoRxo

from the shale base line) which is an Rmf/Rw ratio of 6 or less. Under this condition Rxo (flushed zone resistivity) will be six times Ro (the uninvaded zone resistivity if it contained formation water only) or less, but Rxo still is less than Rt for a zone containing producible hydrocarbons.

The Induction Log application is in the area where the static SP is greater than 40 millivolts (negative deflection) which is an Rmf/Rw ratio of 4 or more. Whenever this ratio is 4 or more, Rxo is sufficiently greater than Ro so that the effect of normal invasion on the Induction tool is negligible in water sands. However, Rxo still is close enough to Rt for a producing zone so that again there is little effect from normal invasion.

The Welex Induction Electric Log may be run simultaneously with a Lateral Curve of spacing 16 or 24 feet, in which case, considerable information may be obtained in water bearing zones where the Rmf/Rw ratios are high, and in possible productive zones where the Rmf/Rw ratios are relatively low.

The effect of bed thickness is over and above the previous discussion. The Guard Log will give accurate values in zones 1½′ thick or greater, while the Induction Log will give accurate values in zones 3′ thick or greater if adjacent beds have a greater resistivity than the zone of interest. If the adjacent beds have less resistivity, the Induction Log will give accurate values in zones 5½′ thick or greater. In the case of thinner beds the Lateral Curve is significant in defining these thin resistive zones. In laminated sections such as hydrocarbon bearing zones alternating with shale streaks having lower values, the Lateral Curve will indicate the presence of higher resistivity.

Porosity Determination . .

FoRxo, NEUTRON OR ACOUSTIC VELOCITY?

The type of porosity present usually can be answered from the geological knowledge of the area. It will be either intergranular, such as sandstone or crystalline limestone; or it will be fractured and/or vuggy. Generally the FoRxo or Acoustic Velocity Log is the best choice in intergranular formations while the Neutron Log should be used for fractured and/or vuggy types. Either the Acoustic Velocity or Neutron Log may be run in oil base muds. The Radiation-Induction should always be used in air or gas drilled holes since direct resistivity measurements cannot be made under such hole conditions.

As with the resistivity logs, the FoRxo, Neutron, and Acoustic Velocity Logs record a single curve, permitting porosity values to be read directly off the log using the Porosity Scale on the log.

In some formations there will be an overlapping of the three porosity logs, each one giving good porosity values. In these cases, the FoRxo Log generally is the best choice since it measures in terms of resistivity and can be compared directly to the Induction or Guard Log for water saturation calculations.

Saturation Calculations

Figures 3 and 4 are examples of the simplified saturation charts used for calculation and printed on the end of the log.

The nomograph on the left of Figure 3 is used to give the ratio of FoRxo to the Guard reading (Induction reading on the Induction-FoRxo chart), and this value at the proper Rmf/Rw value gives water saturation. Measured Rw values from data in the area should be used if possible, but the SP scale is provided at the top of the chart for use as an alternate method.

Figure 4 is the chart printed at the end of the log where the Neutron or Acoustic Velocity Log has been used to give porosity. (Rmf scale has been set for calculation of Figure 7 only.)

In this case the porosity value measured by the Neutron or Acoustic Velocity Log and the Induction value (Guard value on the Radiation-Acoustic Velocity-Guard chart) are used to gain entry into the water Saturation Section of the chart. This value at the proper Rmf/Rw value gives water

WELEX

saturation. On this chart the SP scale is also provided for use if necessary.

In both types of charts, as shown in figures 3 and 4, the solid lines in the water saturation section are for 2nd invasion and the dashed lines are for 5d invasion.

Induction-FoRxo

Figure 5 is an example of an Induction-FoRxo Log in the Morrow Pennsylvanian of the Panhandle. With the Rmf/Rw ratio of 7.3, Rxo and Rt would be approximately equal in an oil zone as shown by Figure 2. In Zone A the Induction resistivity and lower FoRxo values coincide, showing that Rxo = Rt = 22 Ohms, giving 28 per cent water saturation.

Zone B is shown to be quite variable porosity by FoRxo with a considerably lower induction resistivity value, so that the ratio is the same as the Rmf/Rw ratio. This indicates 100 per cent water.

Guard-FoRxo

Figure 6 is a Guard-FoRxo Log in the Gulf Coast Wilcox. With the Rmf/Rw ratio of 1.15, the Guard/FoRxo ratios of .35 to .6 over the upper section give low water saturation calculations. In the lower sand stringers the higher Guard/FoRxo ratios give higher water saturation values which would be interpreted as transition to water. As shown by all curves, the sands are very broken with numerous thin shale streaks and hard streaks. The detail afforded by this combination allows saturation determinations under very adverse conditions. Over the upper section all of the sections showing curvature on the SP, indicating porosity, have Guard readings higher than FoRxo. As a result net pay can be easily determined.

Radiation-Induction

Figure 7 shows the application of the Radiation-Induction Log in water base muds with Rmf/Rw ratio of 8 in the Strawn Lime in Andrews County, Texas. The upper zone calculations indicate water production as verified by drill stem test. The lower zone calculations are also in accordance with test and completion results. At 10,908' the calculation of 55% water in the 5% porosity is as would be expected. The lower porosity would have a higher water saturation because of capillary effects. From 10,920' to 10,930' the calculated water saturation is considerably lower in the higher porosity. However, below 10,950' the calculated water saturations are high again but in relatively good porosity, indicating a possible transition zone from oil to water.

Radiation-Guard

Figure 8 shows the Radiation-Guard Log over the Arbuckle section of Russell County, Kansas, drilled with a low resistivity mud—Rmf/Rw of 1. This well is a field development well, and the Guard was run in the open hole and the Radioactivity Log was run after casing was set. This results in saving rig time on development wells, but still gives complete information as on the initial wells in the field. In this case the pipe was bailed dry before the R/A Log was run. Detailed saturation calculations are tabulated on the log along with porosity values from the scale at the bottom of the log. Also shown are the open hole tests and completion information.

Induction-Acoustic Velocity

An example of the Induction-Acoustic Velocity Log is shown in Figure 9. It is from the Morrow formation in Ochiltree County, Texas. The Acoustic Velocity Log has been recorded here in conjunction with a caliper. It is advantageous

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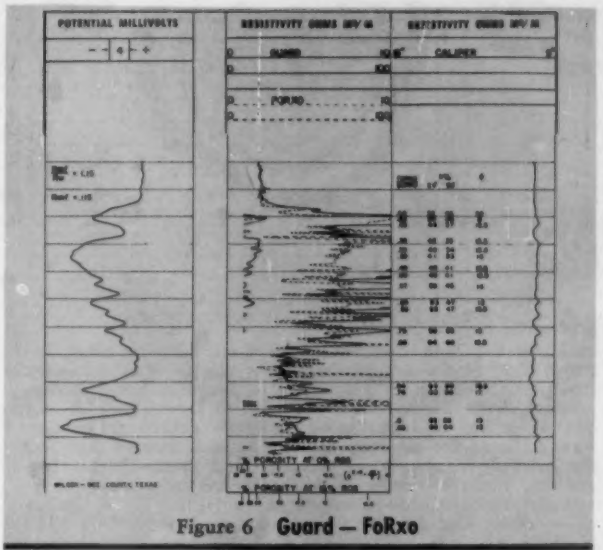

Figure 6 **Guard — FoRxo**

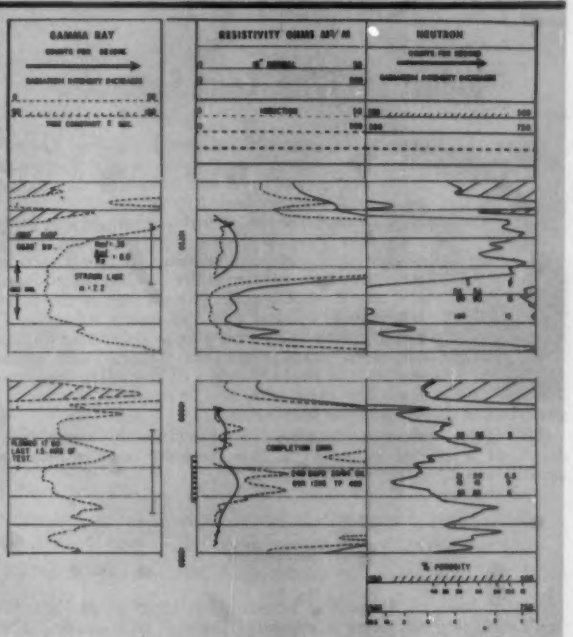

Figure 7 **Radiation — Induction**

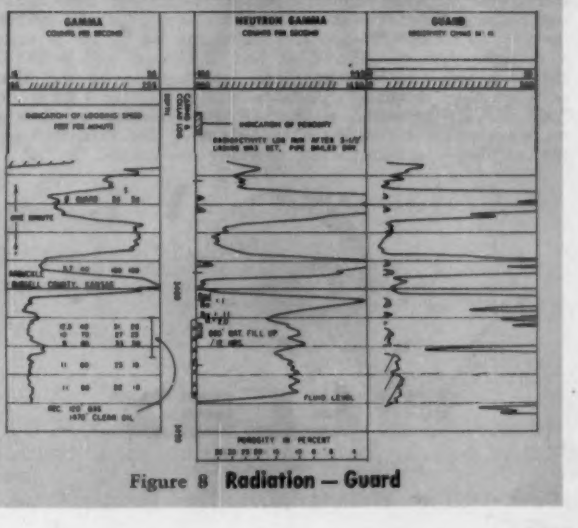

Figure 8 **Radiation — Guard**

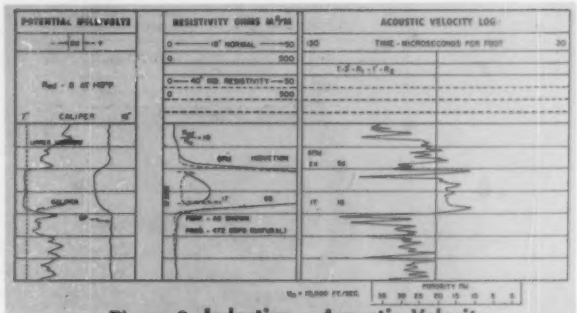

Figure 9 Induction — Acoustic Velocity

to know the hole size since washed-out sections affect the travel time of the acoustic signal to one or both receivers. It is possible to run a Gamma Log or Potential curve in conjunction with the Acoustic Velocity if the caliper is not desired or has been provided by some other combination service. From the porosity (shown by the derived scale on the Acoustic Velocity Log, lithology and the Induction Log reading, water saturation percentages for an available Rmf and Rw value can be obtained using Figure 10. A similar chart is provided for the Guard-Acoustic Velocity Log combination or for any of the porosity-Guard or porosity-Induction devices.

Induction With Long Lateral

Figure 11 shows three examples of the Induction Lateral combination in the Texas Gulf Coast area. Sands A and B occur in the same well and have Rmf/Rw ratios of 10 and 6 respectively.

A comparison of resistivity values on both curves in Sand A clearly illustrates the utility of this combination in instances where a section is water bearing, invasion is probably deep, and the Rmf/Rw ratio is relatively high. Sand B produces oil and gas. The lower values indicated by the Induction Log as compared to the optimum value from the Lateral (25 ohm-meters) is probably due to the relatively low Rmf/Rw ratio of 6 and invasion occurring to perhaps the same extent as in Sand A.

The lower example (Section C) illustrates the correlative detail of a lateral curve in a thin resistive section that is usually averaged by the Induction Log.

Summary

Use of Welex's Simplified Logging Program allows saturation and porosity determinations quickly and easily. The principles upon which the approach is based are not new, but the presentation of the method shows the logic and reason of log interpretation without laborious calculations from equations which at times obscure the effect of the various factors involved. This presentation also shows the log curves in such a manner that the effects of bed thickness, interbedding, shaliness, etc., can be taken into consideration by the user with reliable results. In addition the Saturation Charts or "pigtails" are presented so that all the variables are shown on the applicable chart, and the effects of the variations on the calculated saturations can be easily determined.

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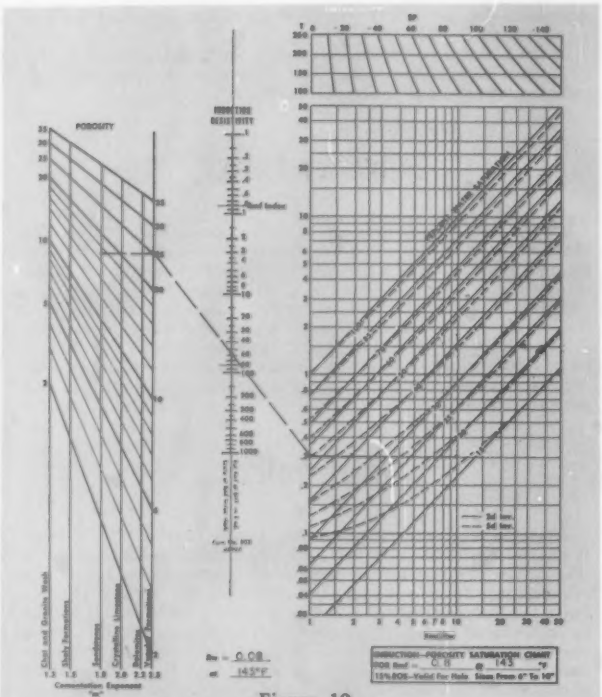


Figure 10

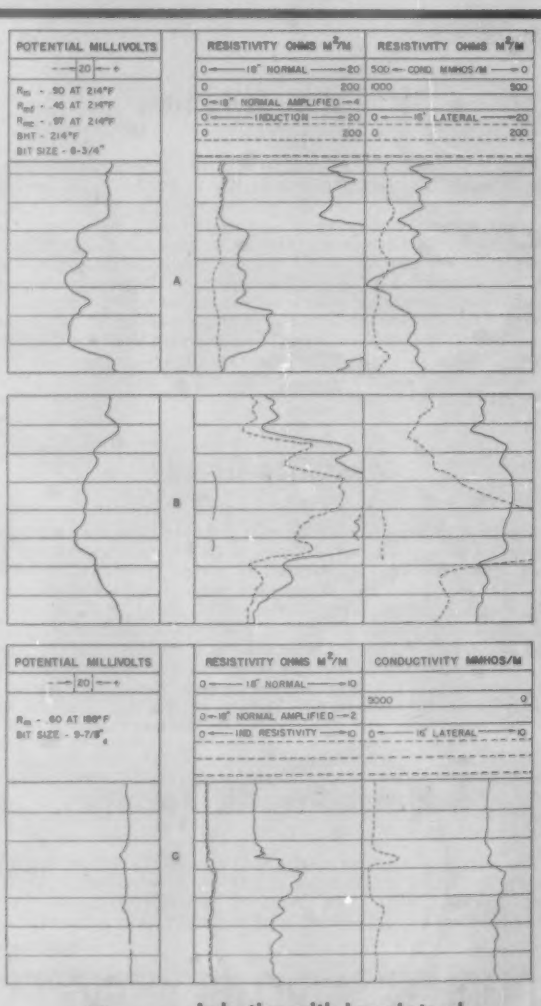
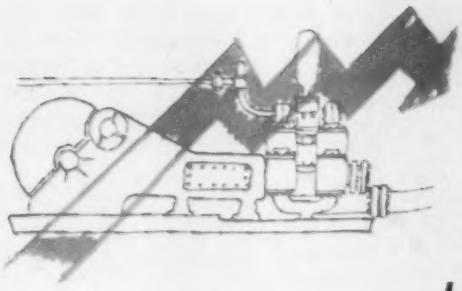


Figure 11 Induction with Long Lateral



Poor mud means

lower pump efficiency, higher drilling costs

BY JACK MARSEE AND R. J. DURAN
Loffland Bros. Co., Tulsa

This article has been prepared for two reasons:

1. Some of the muds we frequently use today are cutting the volumetric efficiency of our mud pumps. Result is often higher overall drilling cost.

2. The loss of efficiency is sometimes unrecognized and tends to destroy confidence in our hydraulics calculations.

The following muds are some which tend to reduce pump volumetric efficiency:

1. Salt-gel, starch mud. Use of oil with this mud usually cuts efficiency further. Using too little preservative to prevent fermentation of the starch results in additional loss of volumetric efficiency.

2. Gyp. Q-Broxin mud without sufficient Q-Broxin and proper pH control. Unless this mud is properly controlled by chemicals and dispersing agent, it reverts to the characteristics of the old gyp-base mud and becomes as difficult to pump.

3. High-pH lime mud with poor pH and lime-content control.

4. Ordinary bentonite muds contaminated with salt, cement, or anhydrite.

5. Native muds containing too many solids inadequately dispersed. Solids level can be high enough that dispersants are no longer effective.

Tables 1 through 4 show clearly the results of using such muds in the field. Compare the poor volumetric efficiency with the values calculated on the 90% efficiency which we usually assume. The actual efficiencies are calculated by the standpipe-gage pressure.

When we fail to get an efficiency as high as we expect, we introduce errors into the hydraulics program we plan. Such errors tend to destroy the confidence of many in hydraulics calculations and impair their ability to prepare a good hydraulics plan. Too often when the mud causes low volumetric efficiency, and standpipe pressure doesn't go as high as it ought, the reason isn't recognized.

Bit No. 24
Morning tour—1,500 psi. with 48 s.p.m.
Day tour —1,250 psi. with 52 s.p.m.
Evening tour —900 to 1,100-psi. with 52 s.p.m.

Not mechanical problem. Volumetric efficiency is the ratio of the quantity of liquid actually pumped to the displacement of the pump. Obviously, if there is failure of the hydraulic components, the pistons, packing, or valves, volumetric efficiency is cut. Also, volumetric efficiency is affected by design of the pump suction and the pump itself.

You may suspect you are losing volumetric efficiency when actually a leak or a faulty gage is to blame for the pressure reading which is lower than you expect. Such things are not our concern here. In the examples which follow, we believe that poor pump performance is the result almost entirely of the type of mud used.

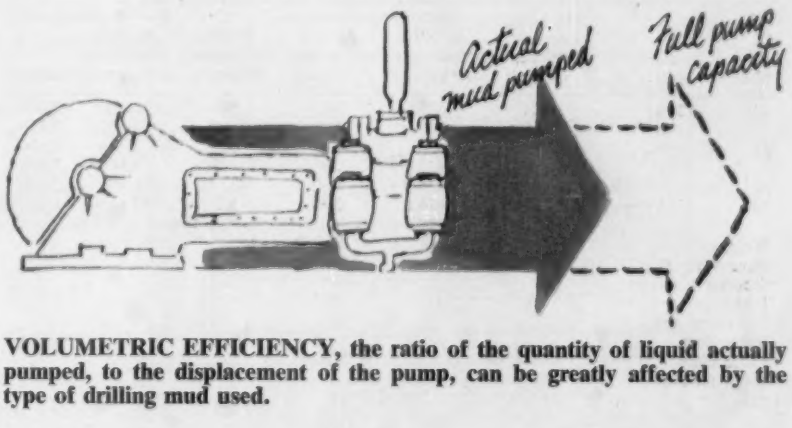
As we examine the cases with such losses of volumetric efficiency, there is an immediate complication because the loss is not usually a constant value. This is shown by the following field case:

Bit No. 25
Morning tour—850 psi. with 52 s.p.m.
Day tour —800 to 1,000 psi. with 52 s.p.m.
Evening tour —Trip-pump out of hole

The driller's first problem is apparent. Unless the condition of the drill string is very good, he cannot eliminate the possibility of washout and failure when the pressure fluctuates to a low value as illustrated here.

The hole obviously was not circulated satisfactorily. This fact is evident in the loss of time to make a trip because of drill-string drag and bridges; then, the hole had to be circulated to remove the accumulated cuttings and to eliminate the hazard of stuck pipe. This loss of time prompted us to investigate the situation.

The mud company report listed the properties of the salt-gel, starch mud used, as follows:



VOLUMETRIC EFFICIENCY, the ratio of the quantity of liquid actually pumped, to the displacement of the pump, can be greatly affected by the type of drilling mud used.

This article is abridged from a paper titled, "The Effect of Various Mud Types On Pump Volumetric Efficiency," presented at 1961 meeting, API Division of Production's Mid-Continent District, Tulsa.

Mud weight	9.2	Initial gel	8	Chlorides	18,000
Funnel viscosity	44	Final gel	12	Calcium	Heavy
Stormer viscosity	38	Water loss	26	Sulfate	Heavy
Apparent viscosity	19	Cake thickness	4/32	Preservative content	0.35
Plastic viscosity	10	Sand content	2%	Oil	5%
Yield point	18	pH	6.8	Solids	12%
				Filler	4 lb./bbl.

Viscosity and gel-strength are so high that any gas produced by the well would not be quickly released. The preservative content is too low to protect against fermentation of starch which releases gas to be entrained in the mud.

The pump was examined and found in good condition. There were no leaks in the circulating system. Thus, the inability to circulate stemmed from the drilling mud's effect on the volumetric efficiency of the pump.

During the time when pump pressure was 1,500 psi. at 48 s.p.m. the pump efficiency was about 95%. When pressure dropped to 800 psi., the volumetric efficiency was calculated to be 62%; this would result in a circulation rate of 285 g.p.m. and an annular velocity in the 8¾-in. hole of slightly more than 120 ft. per minute. In this particular area, we consider 150 ft. per minute to be the minimum for good hole cleaning. Thus, the 120-ft. per minute rate was probably the cause of the drill-string drag and the bridges found on the trip into the hole.

Increase liner size. It is common where loss of volumetric efficiency is prevalent to use an oversize liner. Then, if volumetric efficiency is poor, the pump may be speeded up and a satisfactory circulation rate maintained regardless.

In the Panhandle, where this trouble occurred, the problem is further complicated by loss of circulating that hinges on a rather narrow margin of pressure. Thus, before going to a larger liner as a remedy for the trouble just described, we studied the situation further. At 1,500 psi. and 48 s.p.m., pressure distribution within the system calculated the following:

Circulation rate	400 g.p.m.
Mud weight	9.2 lb. per gal.
Circulating pressures required:	
Surface piping	26
Drill pipe	456
Drill collars	386
Jet-bit nozzles	391
Drill-collar annulus	126
Drill-pipe annulus 7⅞-in. hole	33
Drill pipe 8¾-in. hole	62
Total circulating pressure	1,480 psi.

Annulus velocity:
in 8¾-in. part of hole—175 ft. per minute
in 7⅞-in. part of hole—235 ft. per minute

Speed, pressure control. These velocities are certainly adequate for good hole cleaning, so there was no point in risking loss of circulation by pumping at a higher rate. Suppose we had gone to a larger liner on the bit where trouble occurred

TABLE 1—SALT-GEL, STARCH, OIL-EMULSION MUD

Bit No.	Nozzle size	Indicated volumetric efficiency per cent	Gallons per minute: At 100% volumetric efficiency	Gallons per minute: At 90% volumetric efficiency	Gallons per minute: At ind. volumetric efficiency	Pressure: At 90% volumetric efficiency	Pressure: Actual	Annular Velocity: At 90% volumetric efficiency	Annular Velocity: At ind. volumetric efficiency	Nozzle Velocity: At 90% volumetric efficiency	Nozzle Velocity: At ind. volumetric efficiency
33	7/16	67	600	540	400	2,700	1,500	220	160	385	285
34	7/16	55	600	540	330	2,715	1,000	220	135	385	235
35	3/8	71	422	380	300	1,925	1,200	150	120	365	290
36	3/8	74	422	380	310	1,925	1,300	150	125	365	300
37	3/8	74	422	380	310	1,950	1,300	150	125	365	300
38	7/16	73	600	540	440	2,750	1,800	220	180	385	310
39	7/16	73	600	540	440	2,775	1,800	220	180	385	310

Representative Mud-Property Values

Weight - actual	10.4	pH	6
Weight - flow line	9.8	Salt	330,000
Funnel viscosity	45	Sand	3/4%
Stormer viscosity	36	Per cent salt water	82.8
Initial Gel	0	Per cent free salt	0.2
10-minute gel	5	Solids	6%
Water loss	11.6	Oil (No. 2 diesel)	11%
Filter cake	3/32		

TABLE 2—GYP, Q-BROXIN

Bit No.	Nozzle size	Indicated volumetric efficiency per cent	Gallons per minute: At 100% volumetric efficiency	Gallons per minute: At 90% volumetric efficiency	Gallons per minute: At ind. volumetric efficiency	Pressure: At 90% volumetric efficiency	Pressure: Actual	Annular Velocity: At 90% volumetric efficiency	Annular Velocity: At ind. volumetric efficiency	Nozzle Velocity: At 90% volumetric efficiency	Nozzle Velocity: At ind. volumetric efficiency
49	13/32	84	407	365	340	2,460	2,000	215	200	300	280
50	7/16	75	428	385	320	2,405	1,600	225	190	275	225
51	7/16	75	428	385	320	2,390	1,600	225	190	275	225
52	7/16	79	407	365	320	2,500	1,800	215	190	260	225
53	1/2	82	407	365	335	1,980	1,600	215	195	200	180
54	7/16	82	434	390	355	2,540	2,000	230	210	280	255

Representative Mud Property Values

Weight	11.2	Chloride p.p.m.	450
Funnel viscosity	60	Solids, per cent	20
Stormer viscosity	60	Calcium	1,200
Initial gel	20	Preservative	0.2
10-minute gel	60	Carbonates	0.2
Water loss	4.4	Bicarbonates	20
Filter cake	2/32	Plastic viscosity	31
Sand, per cent	1	Yield point	32
pH	9	Oil	2

Lane-Wells has the *RIGHT* logging package for your well

Developing the maximum information from a logging program depends on having the right log at the right time for the specific conditions of your well. In Lane-Wells' wide variety of reliable logging services you will find the right tool or combination of tools for every hole condition.

For lithology, correlation, bed boundaries, Rt and Sw determination, the Electrolog*, Induction Electrolog and Minilog*-Caliper are excellent fresh mud tools. In salt mud conditions, this information is best developed by the Focused Log and the Minifocusedlog*.

All Lane-Wells log headings are prepared in accordance with API standards, and film width conforms with the same specifications.

For porosity, the Dual Spaced Acoustilog*, exclusive with Lane-Wells, is outstanding for its accuracy and correlatibility with other L-W logs.

Many special purpose services are available for information on hole conditions, cement bonding, the presence of chlorine, gas-bearing strata, and fluid movement in the well bore.

There is a Lane-Wells logging tool to investigate every parameter leading to competent formation evaluation. Ask your L-W representative for a copy of the Preferred Logging Program. It shows at a glance the correct log or combination of logs for every situation in your particular geographical area.

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The COMPLETE SERVICE Company

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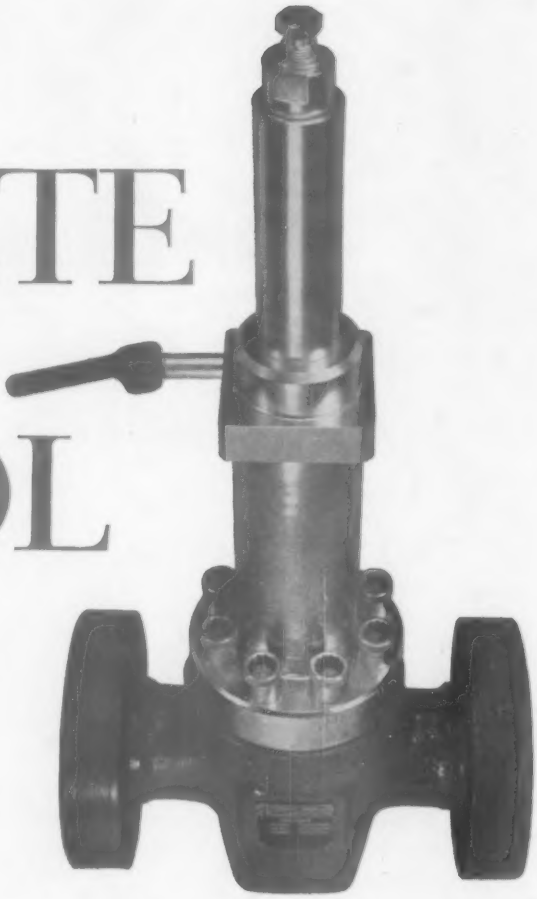

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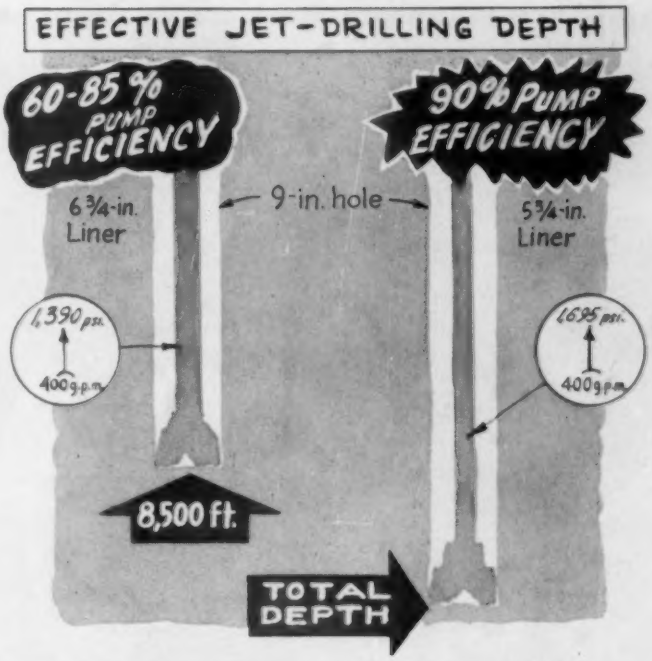
we would have wanted to hold circulation rate to a value no higher than the previously established rate of 400 g.p.m.

The problem is in knowing how to do this. Obviously, control of pump speed is not the answer, for with volumetric efficiency low enough it may not be possible to pump 400 g.p.m. with a larger liner even at maximum speed.

The other factor we might control is pressure, but this too has some pitfalls. With the hole in obviously poor shape the danger of plugging a jet bit is high, so probably a conventional bit would be run.

A good conservative course of action would be to stand most of the drill-collar string back and go in the hole without them, but few contractors with a conservative approach are in business today. So in all probability the full collar string would go back in the hole, just as was the case here.



BETTER MUD which permits a 90% efficiency will allow the use of smaller liners, higher pressures, and use of jet bits to total depth.

TABLE 3—HIGH-pH LIME MUD

Bit No.	Nozzle size	Indicated volumetric efficiency per cent	Gallons per minute: At 100% volumetric efficiency	Gallons per minute: At 90% volumetric efficiency	Gallons per minute: At ind. volumetric efficiency	Pressure: At 90% volumetric efficiency	Pressure: Actual	Annular Velocity: At 90% volumetric efficiency	Annular Velocity: At ind. volumetric efficiency	Nozzle Velocity: At 90% volumetric efficiency	Nozzle Velocity: At ind. volumetric efficiency
75	7/16	81	535	480	435	2,165	1,750	155	140	340	310
76	7/16	85	535	480	435	2,175	1,900	155	145	340	320
77	3/8	72	535	480	385	3,155	2,200	155	120	465	370
78	3/8	75	535	480	400	3,170	2,200	155	130	465	385
79	3/8	79	465	415	370	2,295	1,800	130	115	400	355

Representative Mud-Property Values

Weight	10.1	Sand	1/2
Funnel viscosity	56	pH	12.3
Initial gel	3	Salt	25
10-minute gel	27	P_f	1.9
Plastic viscosity	20	P_m	9.5
Yield point	10	Lime	2.5
Water loss	5.6	Oil	10.8
Filter cake	2/32	Solids	16

TABLE 4—ANHYDRITE CONTAMINATED GEL-CHEMICAL MUD

Bit No.	Nozzle size	Indicated volumetric efficiency per cent	Gallons per minute: At 100% volumetric efficiency	Gallons per minute: At 90% volumetric efficiency	Gallons per minute: At ind. volumetric efficiency	Pressure: At 90% volumetric efficiency	Pressure: Actual	Annular Velocity: At 90% volumetric efficiency	Annular Velocity: At ind. volumetric efficiency	Nozzle Velocity: At 90% volumetric efficiency	Nozzle Velocity: At ind. volumetric efficiency
4	3/8	82	490	440	400	2,320	1,900	180	165	430	390
5	3/8	75	490	440	365	2,360	1,600	180	150	430	355
6	3/8	Bit partially plugged				Dulled using 50 s.p.m. and 2,200 psi.					
7	3/8	89	465	415	415	2,190	2,100	170	170	405	400

Representative Mud-Property Values

Weight	9.5	pH	12.5
Funnel viscosity	37	Water loss	42
Apparent viscosity	16	Filter cake	3
Plastic viscosity	11	P_f	1.8
Yield point	10	Chlorides, p.p.m.	1,200
Initial gel	0	Calcium, p.p.m.	400
10-minute gel	6	Sand	1/2

Congrats and $25 for this quip to Mrs. Merlyn Goodman, Rt. 5, Box 742, Shreveport, La.

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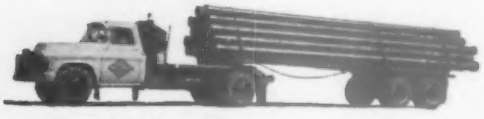
Neighbor, wherever you are, specify Lone Star and we both get a good deal.



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The driller is accustomed to seeing 1,500 psi. on the gage and, if left without instruction, would try for this pressure as mud conditions improved. If this were to happen, the circulation rate and pressure distribution in the system would be about as follows:

Circulation rate	440 g.p.m.
Mud weight	9.2 lb. per gal.
Pressures required:	
Surface connections	31
Drill pipe	561
Drill collars	465
Bit nozzle	188
Drill-collar annulus	150
Drill-pipe annulus: 7⅞-in. hole	48
8¾-in. hole	78
Total pressure	1,521 psi.

Here's the point. Initially the 1,500 psi. operating pressure included 398 psi. lost through the jet nozzles. Conventional water courses require much less pressure. So, if 1,500 psi. is the requirement of both systems, obviously a higher circulation rate will be used with the conventional nozzles. There will be a rearrangement of the pressure distribution. Annular pressure, the only circulating pressure having any bearing on lost circulation, would increase from 221 psi. to 276 psi. This has the effect of increasing the circulating mud weight, from 9.7 lb. per gal. to nearly 9.9 lb. per gal.

In most areas this would be insignificent, but in the Panhandle it might be enough to start a circulation loss. As insurance against loss of circulation brought on by use of the larger liner, we would have to limit pressure. In the case of the bit run following the trip trouble, the limit would be 1,250 psi. as the following tabulation shows:

Circulation rate	400 g.p.m.
Mud weight	9.2 lb. per gal.
Circulating pressures required:	
Surface piping	26
Drill pipe	479
Drill collars	387
Water courses	147
Drill-collar annulus	126
Drill-pipe annulus: 7⅞-in. hole	38
8¾-in. hole	62
Total pressure	1,256 psi.

Larger liners not cureall. Following this experience, we adopted a practice of equipping each pump on a Panhandle rig with a different liner size. The pump with the small liner is used when mud conditions

are favorable and volumetric efficiency is good. The pump with the large liners is for use when conditions are poor.

Following is an example of our experience with the arrangement. The drilling pump—the one with small liners—had to be shut down for repair. The other pump was inadvertently put on the hole at 57 s.p.m. and 800 psi. circulating pressure. The maximum permissible pressure of 600 psi. could be obtained with 50 s.p.m.

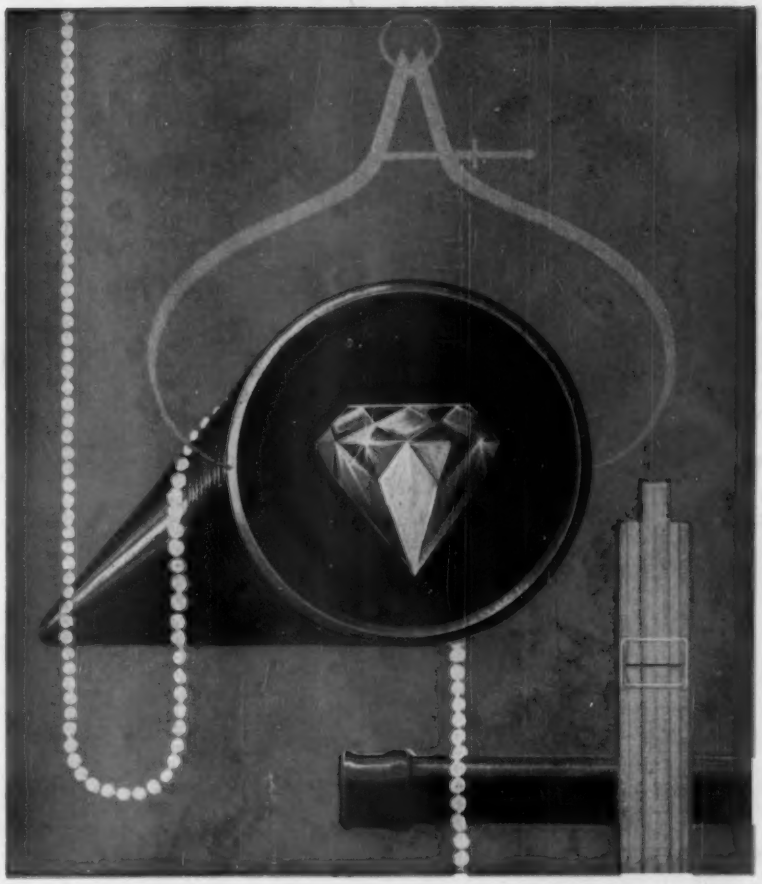
Annulus pressures were calculated at 144 psi., when the pump was operated at 50 s.p.m. and 178 psi. with 57 s.p.m. This represents a difference in head of 72 ft. and an increase in circulating density from 10.0 lb. per gal. to 10.2 lb. per gal. Circulation was lost in 10 minutes after the large-linered pump went on the hole but it was possible to see the fluid level a few feet below the ground level. We took the usual recovery measures, including slowing the pump, and circulation was regained.

If there were no problem of volumetric-efficiency loss, we could equip the pumps with the proper liner to avoid excessive pressures. Then, we could eliminate the human element related to this particular aspect of the problem.

Stops jet drilling early. Probably, the greatest disadvantage of poor volumetric efficiency lies in the effect on planning for optimum use of the pump. For example, in an area where salt-gel, oil-emulsion mud is used, 6¾-in. liners have been adopted. This size assures a circulating rate adequate to clean the hole. Most contractors in the area have pumps whose pressure limit is 1,390 psi. for this liner size.

Volumetric efficiency varies from 65 to 80%. The lowest efficiency value, with 6¾-in. liners results in a circulation rate of about 400 g.p.m., and annulus velocity of 160 ft. per minute in 9-in. hole. The pressure limit of 1,390 psi. means that use of jet bits must cease at about 8,500 ft. At that depth the circulating pressure, with a jet nozzle that will give a productive velocity, will equal the pressure limit of 1,390 psi.

On the other hand, suppose a mud were used that would permit a normal efficiency in the range of



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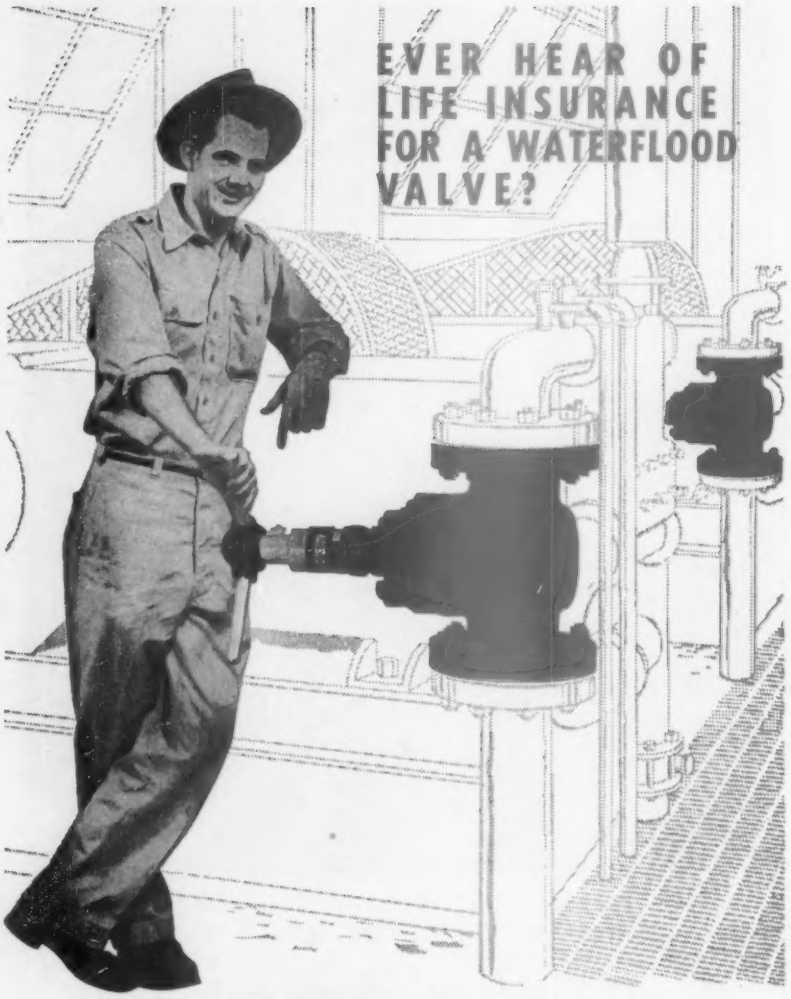

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90%. Then, 400 g.p.m. could be circulated with 5¾-in. liners having a pressure limit of 1,965 psi. This would allow effective jet-bit drilling to total depth of the wells.

By this discussion of volumetric efficiency, we do not intend to influence the industry toward use of muds that **always** permit good pump performance. There are many situations where other subsurface conditions dictate use of a certain mud type. Other factors sometimes prevent our taking advantage of optimum hydraulics. The important point is to recognize what is taking place and to consider loss of volumetric efficiency in evaluating over-all drilling costs. It is certain that many times, the mud does prevent reducing over-all drilling cost as a result of poor penetration rate associated with low pump efficiency.

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BOOK

A HOLE IN THE BOTTOM OF THE SEA. By Willard Bascom. Published by Doubleday & Co., Garden City, N. Y. 352 pp. $4.95.

While much of the scientific effort of the United States has been thrown into space exploration in the last 2 or 3 years, a small group of top-ranking scientists has been planning an equally fascinating and perhaps far more practical exploration in the other direction—down toward the center of the earth.

The objectives of this project, known as the Mohole Project, are to develop the equipment needed to drill a hole 5 or 6 miles down through the earth's crust and to sample the unknown substances in the earth's mantle and overlying sediments.

This book explains the many fields—geology, oceanography, engineering, modern drilling technology, and others—that are being brought to bear on the problems inherent in deep, oceanic drilling.

The equipment required to drill this fantastic hole is a superrefinement of what the offshore oil drillers in Texas and California have recently put into service.

The drill pipe, if translated into familiar scale, would be as long and nearly as limber as a single strand of spaghetti held from the top of the Empire State Building. It is easy to realize that drilling with such a slender tool suspended from the deck of a barge in rough seas somewhere in the middle of the Pacific creates some prodigious engineering problems.

The author shows how the geological and geophysical characteristics of the earth have developed over the ages; and explains volcanoes, earthquakes, seismology, geology, oceanography, and many other things.

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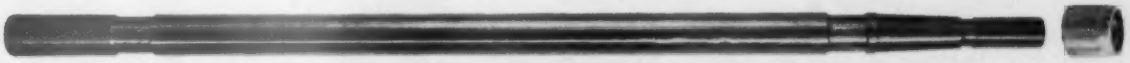

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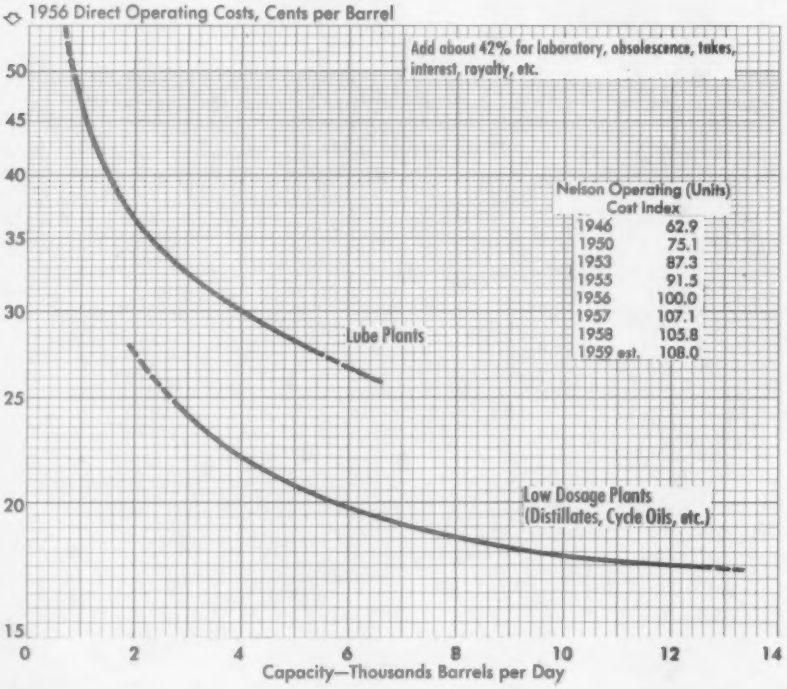
Operating costs—furfural or phenol extraction

BY W. L. NELSON
Technical Editor and Petroleum Consultant

SOLVENT EXTRACTION processes are basically the same. All require heating and stripping of the raffinate and extract, some solvent is lost, and all require contacting of the solvent and oil. Solvent costs and losses vary somewhat but Table 1 and Fig. 1 on this page can be applied with fair accuracy to either furfural or phenol treating. The cost elements of Table 1 can also be applied to Duo Sol plants by making modifications and corrections.

A major variable is the amount of solvent employed. Dosage ranges from less than 0.8: 1.0 in the furfural treatment of cycle stocks, gas oils, and distillates to as high as 2.5:1 in the phenol treatment of naphthenic lube stocks. The effects of this variable on operating costs is retained in Table 1 and Fig. 1. Of course, the customary effects of size or capacity, and of type of management are also important factors in the cost of operating extraction plants.

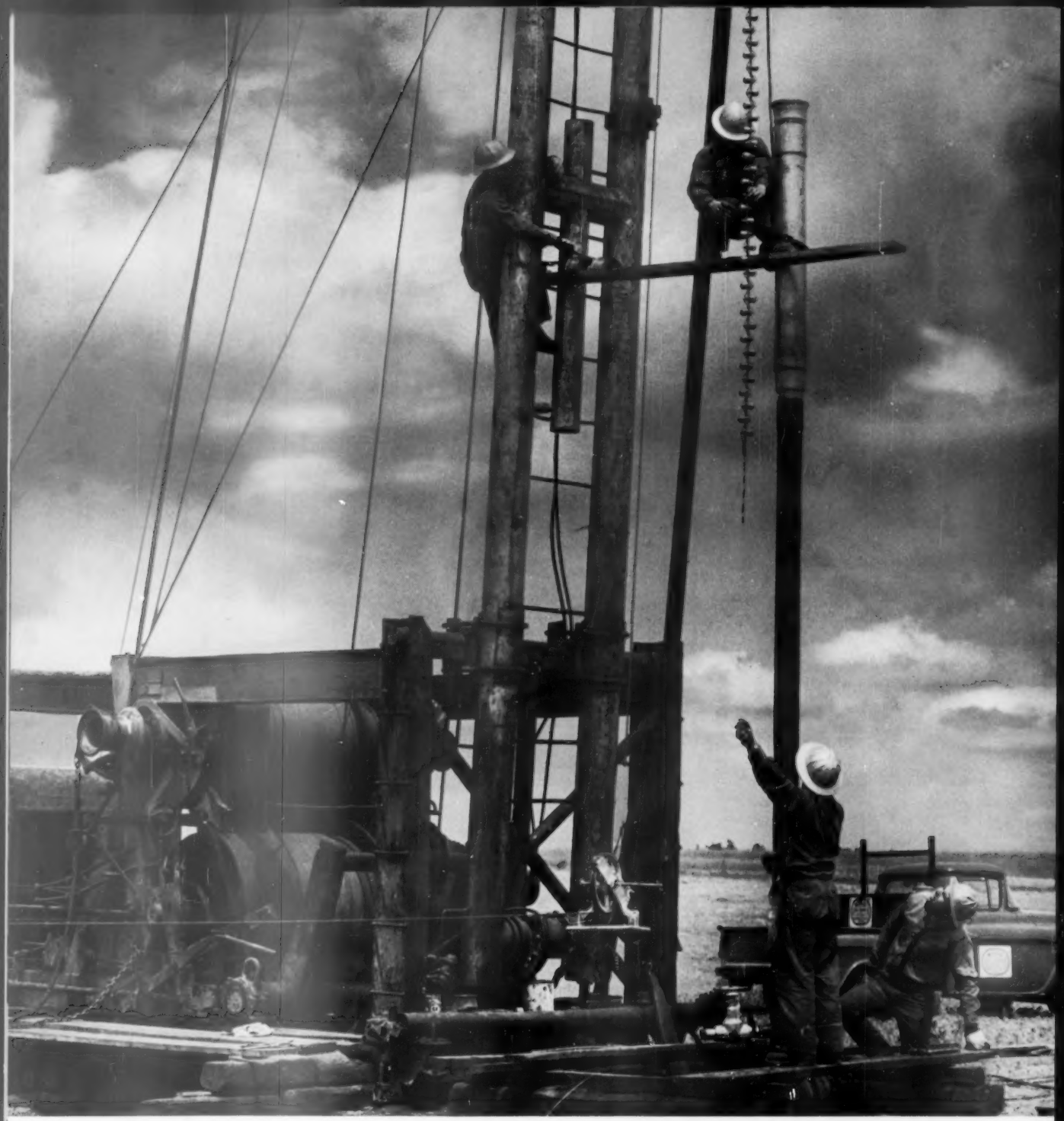


APPROXIMATE average operating costs (1956) of furfural or phenol treating plants. (Independent refiners operate at somewhat lower costs, and major operators at greater costs.)

TABLE 1—ELEMENTS OF OPERATING COSTS—SOLVENT EXTRACTION.

Element	Unit (somewhat standard)	1956 unit cost		Cts. per bbl. (1956) 2,000 B/D 2.0/1.0 dosage	Cts. per bbl. (1956) 6,000 B/D 0.7/1.0 dosage*	Refer to Costimating No.
Labor—supervision	0.4-0.7 men/shift†	$3.85/hr.‡		1.8- 3.2	0.6-1.1	26, 28, 41, 42, 44
Labor—operating	2.0-4.0 men/shift†	$3.12/hr.‡		7.5-15.0	2.5-5.0	
Maintenance	3-5% of replacement	$350-600/daily bbl.§		2.9- 8.2	§1.7-4.9	29
Fuel	80-270 × 10^6 B.t.u./bbl.¶	25-40 ct./M.M. B.t.u.		2.0-10.8	‖1.5-8.1	3, 4, 6
Steam	40-140 lb./bbl.	45-60 ct./1,000 lb.		1.8- 8.4	1.8-8.4	17, 18
Cooling water	50-250 × 10^6 B.t.u./bbl.¶	1.7 ct./M. gal. or 250,000 B.t.u.		0.3- 1.7	‖0.3-1.3	15, 16
Power	0.5-1.2 kw.-hr/bbl.	0.85 ct./kw.-hr.		0.7- 1.0	0.4-0.8	13, 14, 21-23
Solvent—furfural	0.07-0.12% of circulation	$1.16/gal.		6.8-12.7	2.4-4.6	58, 62
or phenol	or 0.02-0.07% of circulation	$1.39/gal.	or	2.3- 8.0	—*	58, 62
DIRECT OPERATING COSTS (probable extremes)				24-51	16-30	
Obsolescence, insurance, interest, etc.	9%/yr. of replacement	$350-600/daily bbl.§		8.4-14.9	5.1-8.8	
Laboratory overhead	1-1.5 men/shift	$3.12/hr.‡		3.7- 5.6	1.2-1.9	26
Royalty	unknown	.....		.....	.....	
OTHER COSTS (probable extremes)				13-19	7-10	

*Applies primarily to furfural treating of distillates, cycle stocks, etc.
†Small or independent refiners tend to use fewer men, and to build plants more cheaply.
‡Average U. S. wages plus 27% for all burdens.
§This cost is for 2,000-bbl. per day lube plants. Gas-oil or distillate plants (6,000 B/D) operating at a low cycle ratio cost only about 60% as much.
¶Heat developed (the absorbed is less by the efficiency). The gas-oil or distillate plants require about 25% less heat.
‖Gas-oil, cycle-oil, or distillate plants of low dosage require only about 75% of the expenditure for lube plants.



Servicing the Herron No. 1. This servicing unit, owned by McKaig Well Servicing Company, Crescent, Okla., was photographed as preparations were being made to reperforate the hole at the Herron No. 1, located near Hunter, Okla. The unit was rigged with 7,000 ft of Bethlehem 9/16-in. 6 x 7 sand line with plastic core, and 8,000 ft of Bethlehem 3/4-in. 6 x 19 drilling line with fiber core. Bethlehem Wire Rope, because of its ruggedness and ease of handling, is ideal rope for servicing units.

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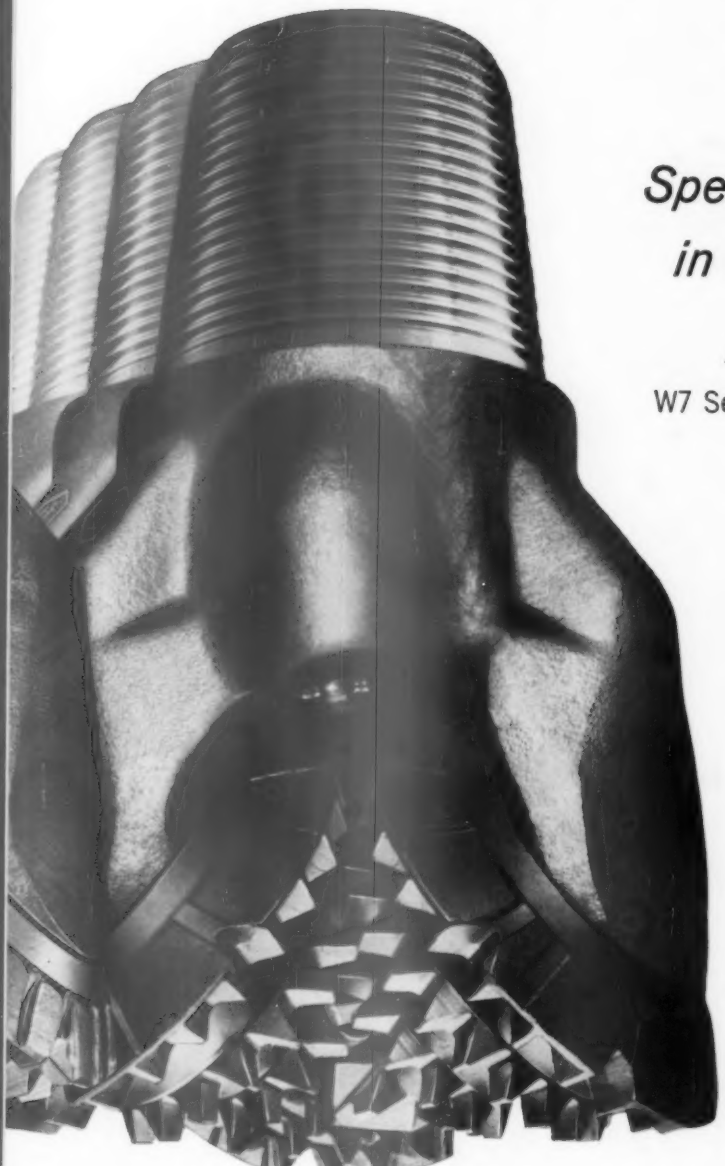

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Change No. 1 has materially increased bearing life through the improvement of metallurgy of rollers and roller bearing surfaces.

Change No. 2 has increased resistance of heel row teeth to gage wear through use of webs connecting heel row teeth.

Where gage wear **is not** a serious factor, the "L" shaped gage on the W7 helps these bits deliver more footage and faster penetration rate. For areas where highly abrasive formations are encountered, two or more teeth are joined by webs to provide increased gage facing and greater resistance to gage wear. In the W7R-2, webs join the heel teeth in pairs. The W7R has three or more teeth joined by webs.

Change No. 3 has permitted use of increased weight on bit, and equalized wear on all three cones. This has been accomplished by redesigning the cutting structure and cone shell.

Change No. 4 has extended cutting life of bit in areas where nose bearing wear is serious. This has been done through the use of improved integral pilot pin bearing.

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Today's Hughes bits come to you under the same series names they have for years... but there's a whale of a difference between the performance of the old and new bits. That's why you get the most hole per bit today with Hughes bits. And why you'll get more tomorrow. To keep your hole costs down — go all the way with HUGHES.

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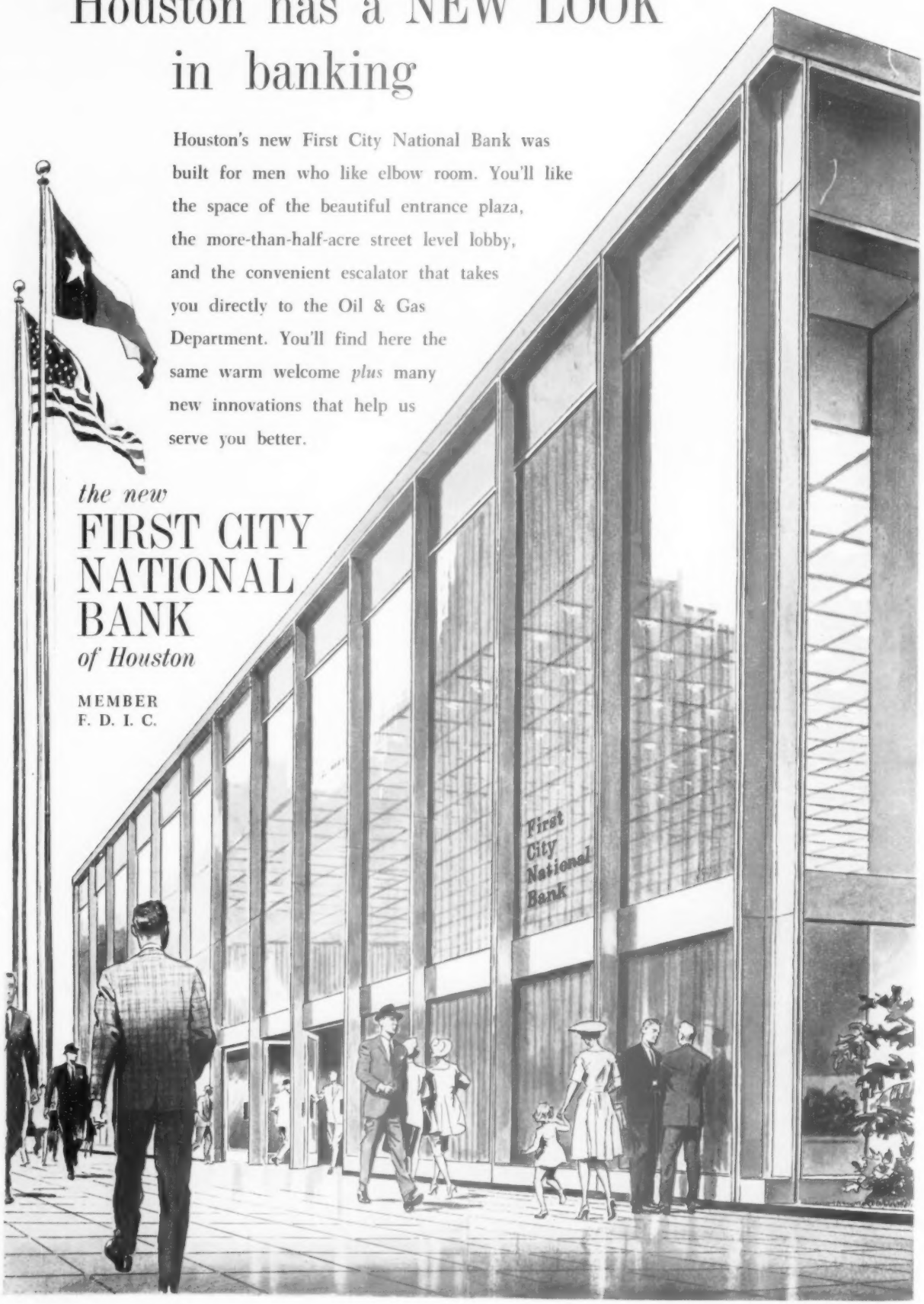

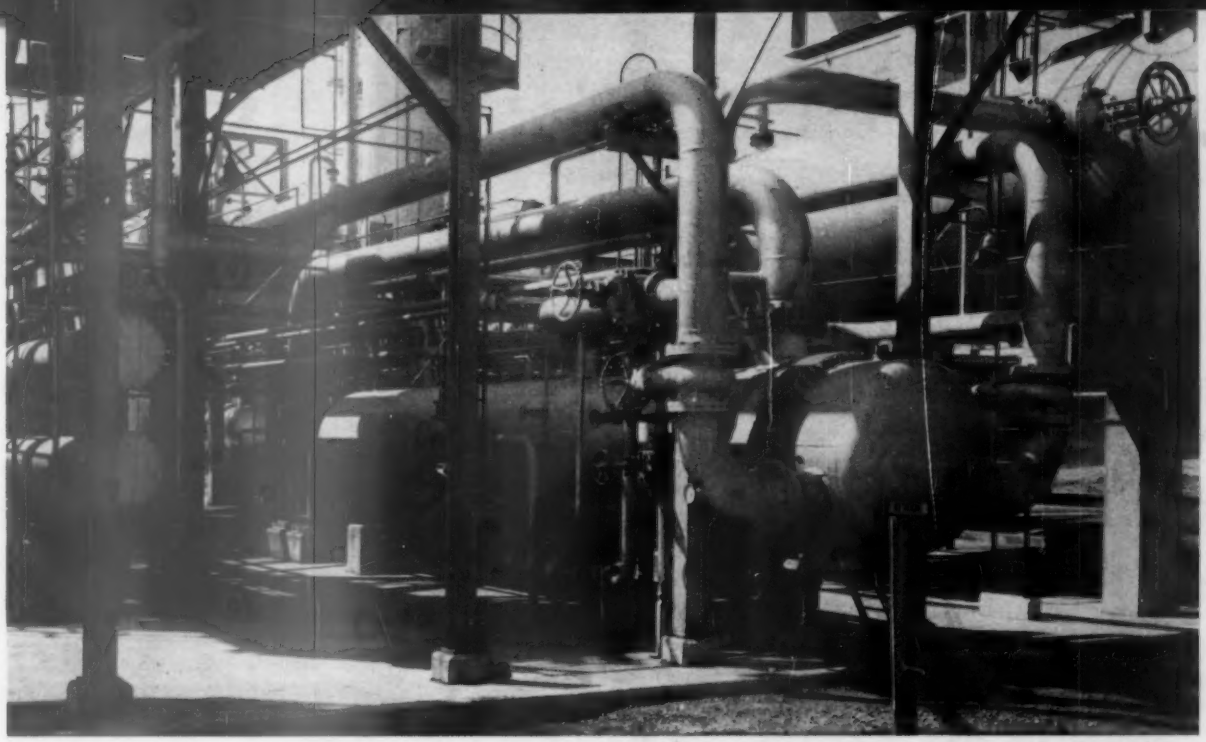

NEW UNIT produces a 104.4 leaded RON product at a 90° F. reactor temperature. Large vessel in foreground is HF-hydrocarbon contactor with mixing pump in left center. Acid settler is at upper right.

Compact layout, low upkeep, fast turnaround

. . . These are built-in features of new alkylation unit

BY STANLEY WEIL
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Cushing, Okla.,
AND G. W. G. McDONALD
Universal Oil Products Co.,
Des Plaines, Ill.

SEVERAL IMPORTANT modifications designed to improve quality, increase yields, reduce costs, improve safety, and decrease maintenance have been incorporated into the design of Midland Cooperatives, Inc.'s 1,300-bbl. per stream day HF alkylation unit.

The unit was recently put on stream at the company's Cushing, Okla., refinery.

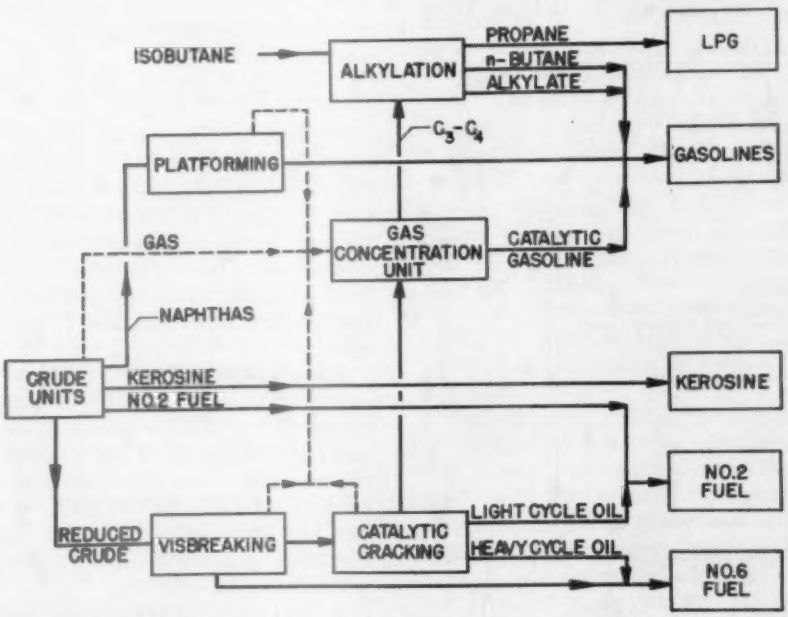
Designed and licensed by Universal Oil Products Co. and constructed by Procon, Inc., the plant includes these features:

. . . One of the first reactors to be built using conventional equipment designed with particular attention to the factors influencing reaction conditions.

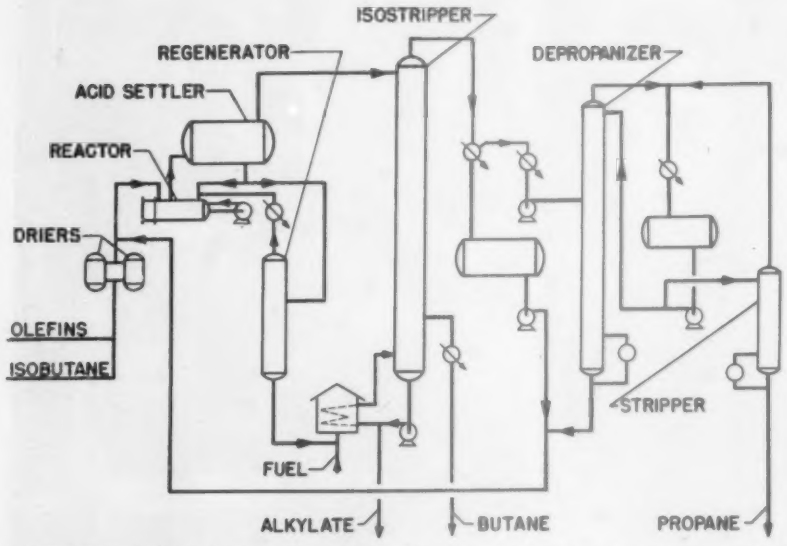
. . . Many maintenance problems either have been eliminated or minimized by designing all sections of the unit for acidic conditions.

. . . Turnaround time was reduced by modifying the spacing of tower manways, by a carefully designed HF pumpout system, and by providing built-in facilities for completely neutralizing the unit before it is handed over to maintenance personnel.

. . . Unit layout is compact. The whole installation, including control room and most of the cooling tower, occupies an area of about 110 by



COMPLETE RANGE of fuels is produced at Midland's 13,000-bbl. refinery.



ALKYLATION UNIT is designed to charge the C_3-C_4 stream from the gas-concentration unit.

180 ft. laid out around a central pump alley.

New Features

Some polymer is produced by side reactions and is ultimately rejected as HF regenerator bottoms mixed with the HF-water constant-boiling mixture. Care must of course be exercised in the disposal of this material. Midland's solution is to carefully settle the "CBM" and run it to one of the neutralizing basins where it is neutralized directly with lime. Settled organic tar, which has a relatively low fluorine content, is than incinerated in the isostripper reboiler heater.

Drainage. Neutralizing basins insure that drainage from the unit has a minimum fluoride content. The runoff for each 24-hour period is impounded in a basin and treated with lime before being released to the refinery oil separator. Analysis of effluent shows that its fluoride content is about 10 p.p.m. which is further reduced to less than 1 p.p.m. by dilution in the total refinery effluent.

Isobutane unloading. LPG techniques are used for unloading makeup isobutane. A compressor which takes suction from the isobutane sphere pressures the contents of the tank car to storage. When the liquid has been removed, a special reversing manifold permits the compressor to then take suction on the remaining vapor in the tank car and discharge this into the sphere, thereby recovering an additional amount of isobutane, estimated at 75 gal. per tank car.

KOH regeneration. It is not practical to use sodium hydroxide to neutralize traces of hydrofluoric acid, because the relatively insoluble sodium fluoride precipitates and presents plugging problems. Potassium hydroxide is used instead, and is regenerated with common lime through the reaction:

$$2KF+Ca(OH)_2 \longrightarrow 2KOH+CaF_2$$

This precipitates insoluble calcium fluoride and restores the potassium hydroxide solution to its original strength.

Handling lime or other solids is a distasteful job in any refinery. Midland requested UOP to design a bucket elevator system to solve this problem. Considerable labor-saving results on a dusty job which, otherwise, would have to be performed manually.

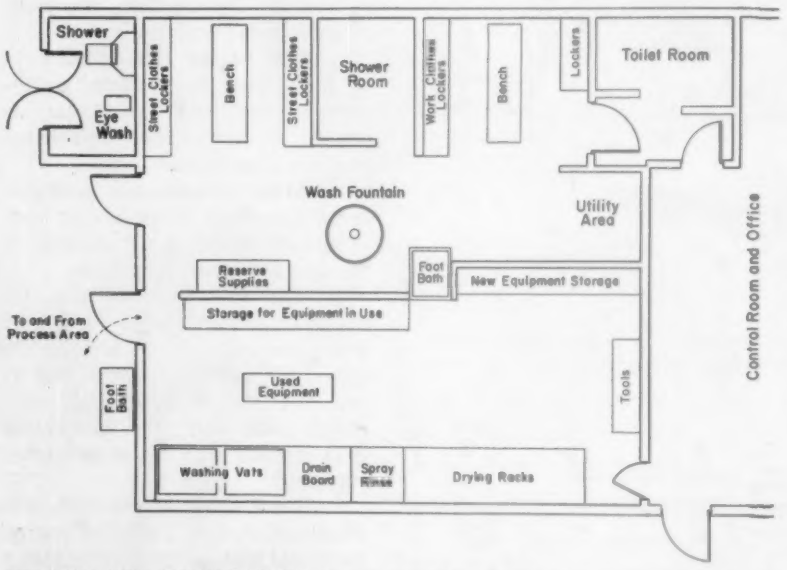
Stream analyzer. A continuous chromatic analyzer is used to monitor the loss of isobutane in the n-butane stream. Through its use the operators are able to maintain isobutane content between 1.8 and 2.2%. Closed loop control is not necessary. Consequently, some time on the analyzer is available when desired for use in checking the composition of other process streams.

Process Scheme

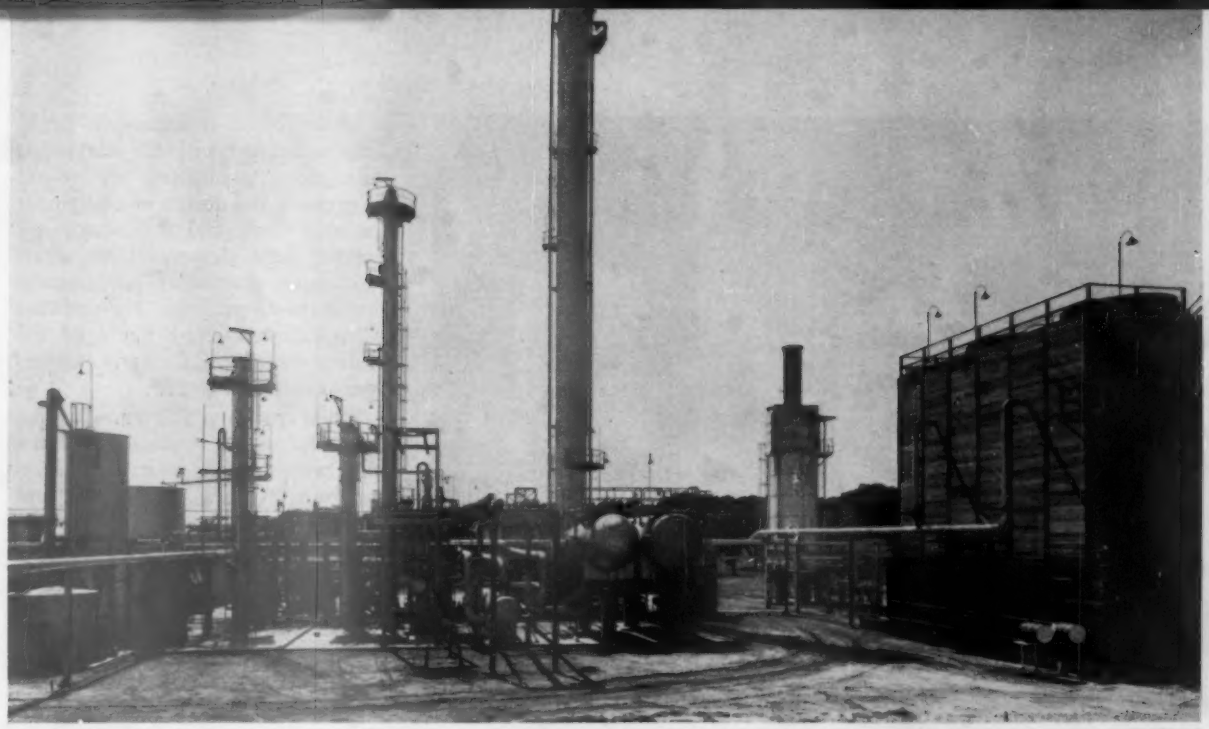
Midland's refinery has a crude throughput of about 13,000 bbl. per stream day. Products include a complete line of gasolines and burning oils. Process scheme employs crude distillation, visbreaking, UOP fluid catalytic cracking, platforming, gas concentration, and HF alkylation.

HF alkylation. The unit is designed to charge the C_3-C_4 stream produced by the gas-concentration unit from both cracked and straight-run streams. No amylenes are processed at this time, although the unit can handle them should such an operation becomes desirable. A diagram shows the unit flow.

A polymerization-unit feed treater, consisting of water and



CONTROL AND CHANGE-ROOM layout provides plenty of storage space. Equipment is geared to give maximum safety to the operators.



COMPACT UNIT is built around a central pump alley and occupies an area of about 110 by 180 sq. ft. Equipment shown from left to right: lime elevator, KOH-lime system, relief gas scrubber, HF stripper and acid regeneration columns depropanizer, isostripper reboiler heater, and cooling tower.

caustic wash towers, was retained in alkylation charge service. Storage for 2,000 bbl. of treated olefinic charge was provided to accommodate minor operating interruptions, although the alkylation unit is normally charged directly from the gas-concentration-unit debutanizer overhead receiver. Since Midland depends on outside isobutane, storage also was provided for 7,000 bbl. of this material.

Both olefinic and saturate feed streams are charged through desiccant driers, operated on an 8-hour cycle, to reduce water content. The total fresh feed is combined with isobutane recycle and injected into the reactor. The heat of reaction—over 4 x 10^6 B.t.u. per hour—is removed in a shell-and-tube exchanger, specially designed to avoid local high temperatures in the reaction zone. Reactor effluent passes to the acid settler, from which settled acid is returned by gravity to the reactor to maintain a high acid-to-hydrocarbon ratio.

Charge to the acid regenerator is a slipstream of settled acid. Regenerated acid is fractionated from a residue of tar and the water-HF constant-boiling mixture. Because of the low water content of the charge and the favorable reaction conditions, it is not necessary to operate the regenerator continuously; during the first months of operation it has been in service from 10 to 20% of the time. Generous regeneration capacity is built into the unit, however, to provide insurance against unexpected charge contaminants or process upsets.

The fractionation section of the plant is conventional. If differs from earlier designs only in that recent experience has made possible the simplification or elimination of many details previously found on alkylation units.

Hydrocarbon effluent from the acid settler is passed to the isostripper which produces the major isobutane recycle stream as overhead product, a sidecut of normal butane, and stabilized alkylate as the bottom product. Since the n-butane stream is produced as a sidecut, it contains about 3-4% pentanes. This is acceptable because this stream is invariably routed to gasoline blending. A fired heater was selected to supply reboiler heat both for economic reasons and to promote the decomposition of combined fluorides.

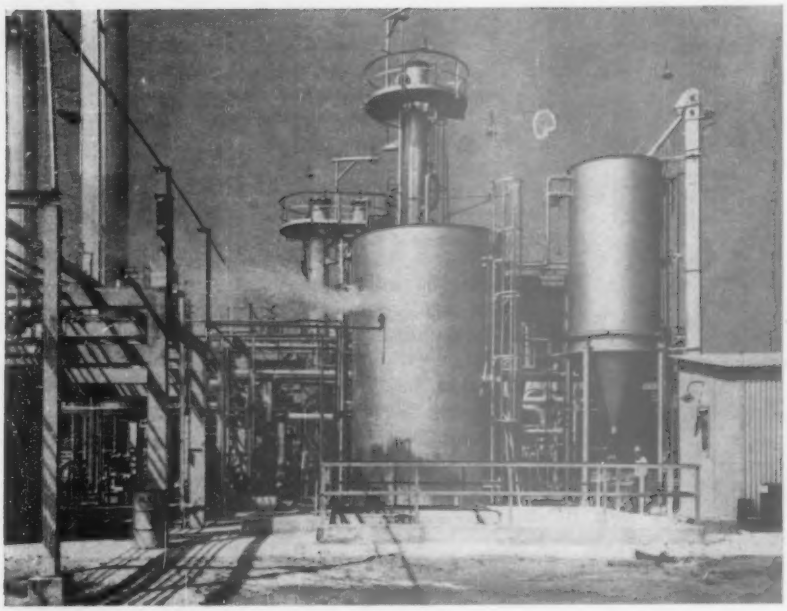
Depropanizer charge enrichment is obtained by fractional condensation of the isostripper overhead to produce the principal isobutane stream as primary condensate and the depropanizer charge as the final condensate. Depropanizer bottoms are recycled to the reactor. HF in the overhead propane product is stripped out in a small stripping tower from which the HF-free propane is yielded as the bottom product.

Note that the process design is such that all products are stripped free of HF before being withdrawn. Nevertheless, the propane and normal butane streams are each passed through separate caustic potash treaters to provide a complete guarantee against any free HF leaving in these streams. However, in 8 months' operation it has been necessary to recharge only one of them and that was because of a pressure-drop problem which arose before the caustic was spent.

Performance. The unit has produced C_3-C_4 alkylate rating as high as 107 research octane number with 3 ml. TEL, but is normally operated to produce an alkylate rating of 104 leaded RON.

The operation was closely studied during a performance test, when it was found possible to operate below the design isobutane recycle rate and yet produce a 104.4-octane-number product at a 90° F. reactor temperature. Table 1 summarizes the composition of the light-hydrocarbon streams. Table 2 shows properties of the alkylate product.

HF consumption. HF consumption during normal operation is averaging about 0.2 lb. per barrel of debutanized alkylate.



BUCKET ELEVATOR at right for loading lime eliminates a dusty job. Effluent neutralizing pits are in center foreground.

Operating costs. During the same performance test a utility survey was made to arrive at an accurate estimate of operating costs. This survey, summarized in Table 3, showed that the 104.4-octane alkylate was produced at a direct operating cost of about 53 cents per barrel, exclusive of royalty, depreciation, and overhead. Operating costs naturally vary with process conditions and product quality, and it is estimated that raising the research octane rating by one unit will increase operating costs by about 4 cents per barrel.

TABLE 1—STREAM COMPOSITIONS (LIQUID VOL. %)

	Olefinic charge	Outside isobutane	Propane product	Butane product
Ethane	Trace	....	0.4	....
Propylene	17.5	....	....	....
Propane	15.2	1.5	98.6	....
Butylenes	32.2	....	....	....
i-Butane	24.1	97.9	1.0	2.3
n-Butane	9.5	0.6	....	94.5
Pentanes	1.5	....	....	3.2

TABLE 2—ALKYLATE PROPERTIES

Sample—	7-Day test run composite: As produced	Debutanized
n-Butane, liquid vol. %	4.4	0
C_5+	95.6	100
R.v.p.	6.0	....
Research octane, clear	93.0	92.9
Research octane, +3 ml. TEL	104.4	104.4
°API at 60° F.	71.5	....
ASTM distillation:		
I.b.p., °F.	121	....
5%	153	....
10%	169	....
50%	210	....
90%	252	....
95%	320	....
E.p.	372	....

TABLE 3—DIRECT OPERATING COSTS, 1,300 BPSD DESIGN CAPACITY

	Dollars per day	Cents per barrel
Labor—supervision:		
Two operators per shift		
Utility man		
Payroll burden at 20%	200.00	16.25
Utilities:		
Steam at 23 cents per 1,000 lb.	30.8	2.50
Value of FCC exchange heat	36.4	2.96
Fuel gas at 21 cents per 1,000 s.c.f.	86.5	7.04
Power at 1.0 cent per kw.	38.9	3.16
Water at 15 cents per 1,000 gal.	6.0	0.49
Operating supplies:		
Hydrofluoric acid at 21 cents per lb.	58.9	4.79
Lime at 1 cent per lb.	5.3	0.43
Potassium hydroxide at 10 cents per lb.	6.6	0.54
Soda ash at 2 cents per lb.	0.7	0.06
Miscellaneous (est.)	0.5	0.04
Miscellaneous (estimated):		
Maintenance	86.1	7.00
Laboratory service	24.6	2.00
Taxes and insurance	73.8	6.00
Total operating cost	*$655.1	*53.26

*Exclusive of royalty, management, and depreciation charges.

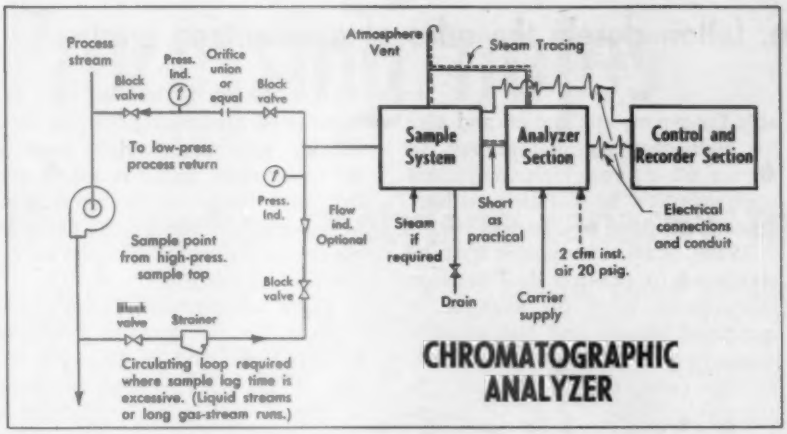
Most of the maintenance problems associated with HF alkylation have been eliminated by recent progress in the design of equipment for acid service. For instance, all pumps, gage glasses, valves, pressure gages, and other instrumentation have monel trim. HF-resistant plastics have solved many of the sealing problems formerly associated with handling HF.

Stress cracking. The startup, however, did see a recurrence of the old problem of stress-corrosion cracking. A flange leak passed unobserved for some time. When the fitters attempted to tighten the B-7 studs, which had been exposed to wet acid vapors, they immediately failed. This problem has been solved by immediately attending to any leak, and by promptly replacing any studs exposed to HF.

Experience shows that in general it takes about 2 days from the time the bolt first comes into contact with the acid until it fails. The chief trouble seems to come in places where flange faces are very close and air circulation is restricted. The operators, however, do not anticipate any change in bolting specifications, since routine inspections solve the problem. During normal operation, leaks are even less common than on any other refinery unit.

Gasoline blending. Midland's gasoline-blending requirement demands that alkylate end point must not exceed 400° F. But, during initial operation, alkylate end point did in fact exceed this specification on occasions. Closer control of reactor conditions has resulted in maintaining the end point between 360° and 390° F., and also in producing a higher-quality alkylate.

Alkyl fluorides. Initially it was felt that, since the propane product from alkylation was to be sold undiluted as LPG, its combined fluoride content might be sufficiently high to cause concern. However, a simple calculation will show that, if propane containing many times the normal fluoride content is burned, the carbon dioxide content of the flue gas will be so high as to represent a much greater toxicity hazard than will the trace of fluoride. Nevertheless, combined fluoride in any effluent stream represents a loss of catalyst, and every precaution is taken to keep these losses to a minimum.



TYPICAL PROCESS CHROMATOGRAPHIC INSTALLATION. System flow is from the process to the sample system, then to the analyzer section, then to the control section, then to the recorder, then to any special outputs that may be required. A block diagram of this type is very helpful for trouble-shooting the analyzer installation. Sampling systems are very often the basic cause of analyzer failure.

The sampling system

—vital link in the process chromatographic control setup

BY F. H. HARVEY AND W. J. BAKER
Greenbrier Instruments, Inc.

THE SAMPLING SYSTEM, installed between the chromatographic process analyzer and the process itself, is a very important part of the analysis and control setup, and contributes in large measure to the over-all success or failure of the project.

There are no smart instruments. The best instrument performance possible accrues when the equipment analyzes accurately the sample it receives. It cannot be expected to guess at what the sample should have been.

The function of the sampling system is to take a sidestream of process material and deliver to the analyzer a representative sample of the process stream at the pressure, temperature, flow, and phase conditions that can be accommodated by the process chromatograph.

Design important. It is important to bear in mind that each sampling system presents a different problem, and serious consideration is required for the transportation lag-time problem and any scrubbing, cleaning, pressure reduction, flow control, etc., that is needed for the particular application. When installing or designing a sample system, the rules of good piping practice should be closely followed with regard to adequate bleeds, vents, drains, block valves, throttling valves, mechanical support, and protection from mechanical damage.

If required for the particular application, sample vents should be provided with snuffing steam connections, drains, and flame arrestors. All lines should be sloped for proper drainage and in the case of multistream applications the valving should be arranged so that solenoid-valve leakage aids in producing a more representative sample to the analyzer of the stream being sampled by keeping the pressure of the analyzer stream higher than the pressure of the bypassed stream.

Temperature important. If the material to be sampled can polymerize or undergo any type of chemical reaction at elevated temperatures, very careful consideration must be given to the maximum spot temperatures that are possible in the sampling system. Hot spots may occur where a steam tracing line touches the sample line and in some types of flash vaporizers. The use of hot water for sample line tracing and flash vaporizers will very often aid in this problem.

In similar fashion if the material to be sampled will freeze near ambient temperatures, i.e., maleaic anhydride, cold spots in the sampling systems can be equally troublesome. The use of a thermal conductive material coupled with steam tracing and insulation, or tube in tube tracing techniques, or submerging the entire system in a hot water bath or steam bath as the case may be will often alleviate these problems.

Sample absorption. A sampling problem common in the process industry is the absorption of sample components on the walls of the sample system piping and hardware. For example, NH_3, HCl, Cl_2, H_2O, etc., are extremely prone to plating out on the sample system walls. Even normally "tame" materials in low-p.p.m. concentrations will be absorbed and desorbed on the walls of vessels and containers and produce a very nonrepresentative output that is not the fault of the analyzer.

As a result, a step change in the sample results in an analyzer response which is similar to a resistance-capacity time constant curve. The problem is further complicated by the variation of this effect with the temperature of the sample system.

Problems involving leakage, etc., are normally not insurmountable, even in the case of the highly inflammable materials which are handled by process-type instruments. However, toxic materials such as HCN, H_2S, phosgene, nickel carbonyl, and the carcennogenic materials provide additional problems, in that very often routine maintenance of the sampling system can produce undesirable results. Materials of construction should be properly chosen to prevent serious corrosion problems in the sampling systems from both the equipment failure standpoint and also the fact that

Adapted from paper presented at sixteenth annual symposium, Instrumentation for the Process Industries, sponsored by department of chemical engineering, Texas A & M College, College Station, Tex.

When installing a system, follow closely the rules of good piping practice

combination and/or corrosion products formed may affect the analytical results of the instrument.

Removing entrained materials. Very often entrained liquids, solids, and materials which are detrimental to the anlysis must be removed by suitable scrubbing, filters, or precipitation of some sort. It is most important that the removal of the undesired component not affect the remainder of the analysis.

A common practice is to install a silica gel drier in series with the sample line to an analyzer handling a wet gas. The silica gel is a very good desiccant and does absorb water but also has a definite affinity for most other materials as well. Therefore, a step change in a hydrocarbon at the input of the sample system will not be shown downstream of the desiccant until the desiccant is in equilibrum with the new stream concentration. If the desiccant bed is reasonably large, the time lag involved may be several days.

As a rule it is generally advantageous to design the analyzer so that it can properly cope with this type problem, i.e., backflushing in a chromatographic analyzer to remove undesirable sample components.

Startup. Prior to providing a process sample to the analyzer break the sampling system at several convenient locations and purge each of the sections in turn, saving the purging of the analyzer for last. This procedure is desirable since very few analyzers are capable of analyzing pipe dope, cutting oil, nuts, bolts, coveralls, or crescent wrenches.

A typical sampling system with its normal complexity runs between 10% and 150% of the analyzer cost, with the average closer to the 100% range.

Equipment Capability

The capability of commercial equipment is always of interest. Analyses with temperature ranges from subambient to 200° C. are in general use. For most of this temperature range, equipment is available for p.p.m. application and also for high-speed chromatography. In almost all cases multicomponent analyses may be handled without serious difficulty or expense.

Much of this equipment may be combined to provide dual-function instruments, with, for example, a combined normal and high-temperature range for abnormally wide-boiling-point separations, etc. In addition a wide variety of accessories, both for the sampling systems and the chromatographic analyzers themselves, are available. These include pressure and flow-control regulators, rotameters, pressure indicators, special valving requirements, peak-reader and memory devices, integrators or other analog-output equipment, and the relay and diode logic involved in feeding data-handling systems and computer-control installations.

Future Developments

A great deal of development work is being carried out, both by the commercial suppliers of process chromatographic instruments and many research facilities.

The hydrogen flame, the beta, and the glow-discharge-ionization detectors are receiving considerable interest and are presently available or will be shortly. The equipment that is being developed is aimed primarily for the 0-5-p.p.m. maximum sensitivity level. The glow-discharge detector in particular shows promise of reaching even greater sensitivities in the p.p.b. range, but the development problems are considerably greater with this detector.

Improvements are constantly being made in the present heated-wire-filiament and thermistor thermal conductivity bridges and cells. Diamond thermistors have just recently been introduced and initial work indicates that these may prove home stable and more sensitive than existing thermistor types. More exotic types of detectors involving principles less obvious are being examined, but the incorporation of these types in the process analyzer is a considerable distance away.

Improved hardware and knowledge of the equipment will make high-speed chromatography more reliable and more widely used in the near future, and it is anticipated that such things as the application of capillary columns, etc., to process chromatography can soon be accomplished reliably.

There will probably be an extension in the temperature range of process equipment to regions in excess of 200° C. However, operation in excess of 200° C. produces a great series of new problems that has forced the development of radically different hardware.

With rare exception the sample and critical column switching valves and detectors are little changed in basic concept from the earliest days of process chromatography. The lessons that are being learned in the handling of the superhigh-temperature problems and the high-sensitivity detector requirements will provide radical improvement in reliability and maintenance ability for process stream chromatography throughout its wide range of possible application.

Control Considerations

The sampling system is a critical part of the process chromatographic control problem. Transportation lag of the sample should be reduced to an absolute minimum consistent with providing the analyzer with a representative process sample.

A close look should be taken at the conventional control system for the tower or reactor in question, i.e., the Δ-P controls, constant-feed-density system, FRC's, TRC's, should all be checked to see if they can handle the expected operating conditions of the vessel concerned.

The normal ARC installation is cascaded into the conventional control loop of either reflux rate or reboiler heat depending on the desired control, assuming a distillation column.

Where possible the control system should be provided with fail-safe features and limits on the maximum change that the chromatographic analyzer may call for. It is somewhat ironical that when dealing with process control problems the analyzer itself is very often the easiest phase of the problem.

Processing notes

Hydrocarbon-acetylene capacity to almost double

FOUR COMPANIES have announced plans in the past year for plants to produce 265 million pounds of acetylene per year from hydrocarbon feed stocks. This almost doubles the petrochemical-acetylene capacity in the U. S.

The renewed interest in hydrocarbon-derived acetylene seems to be more a coincidence than anything else. From all available information the economics for this type of installation haven't changed appreciably from several years ago when the future for making acetylene from hydrocarbon feed stocks looked pretty dim. It still costs about twice as much to build a petrochemical acetylene plant as a comparable-sized carbide unit, and no real technological breakthroughs have been made in the available processes.

But the hydrocarbon - acetylene people claim that in a 100-million-pound per year plant or larger, acetylene can be made for about 5 to 6 cents per pound, and certainly less than 10 cents, if offgases can be profitably used to make other products such as ammonia or methanol. As a comparison, carbide acetylene is selling for about 12 cents per pound in large quantities.

So apparently, a company having a large captive use for acetylene may come out ahead by making its own from a hydrocarbon feed stock if it is in an area of cheap raw material and power.

In these newly announced projects most of the acetylene will be used captively to produce established products and each producer has different reasons for making his own.

Diamond Alkali Co. is building a 35-million-pound per year acetylene plant at Deer Park, Tex., using the Montecatini process for the partial oxidation of natural gas. Diamond explains that it was forced into this project because Rohm & Haas, its sole supplier of acetylene raw material for the vinyl chloride monomer production at Deer Park, decided to use all of its output captively.

Monochem, Inc., jointly owned by Borden Co. and U. S. Rubber Co., was recently formed to manufacture more than 80 million pounds per year of acetylene and 150 million pounds per year of vinyl chloride monomer for captive use by the parent companies. Both companies had previously decided to expand their vinyl plastic operations and it seemed that this tieup was the most logical route for them to follow. Indications are that Monochem will use the BASF process for partial oxidation of natural gas. The plant will be located at Geismar, La.

Tenneco Chemical Co., a subsidiary of Tennessee Gas Transmission Co.-owned Tenneco Corp., has announced plans for a 100-million-pound per year acetylene plant on the Houston Ship Channel. Most of the production will go into the manufacture of vinyl chloride monomer with smaller amounts going into vinyl acetate and possibly neoprene. Ammonia will probably be made from offgases. Cary Chemicals, Inc., has signed a long-term contract to buy a large portion of the vinyl chloride monomer and will probably have an equity in the plant.

Tenneco will also produce acetylene by the partial oxidation of natural gas, but the exact process hasn't been announced. It will doubtless be Montecatini, BASF, or SBA. The feeling is that BASF has the inside track.

Du Pont has plans for a 50-million-pound per year acetylene-from-hydrocarbons plant at Montague, Mich. The plant output will be used in its Montague neoprene plant which previously purchased acetylene from Union Carbide. Since acetylene is its largest single product expense, Du Pont decided to try making some of its own requirements. Also, it has been suggested that with an acetylene plant of its own, Du Pont is in a better position to haggle over prices of purchased material.

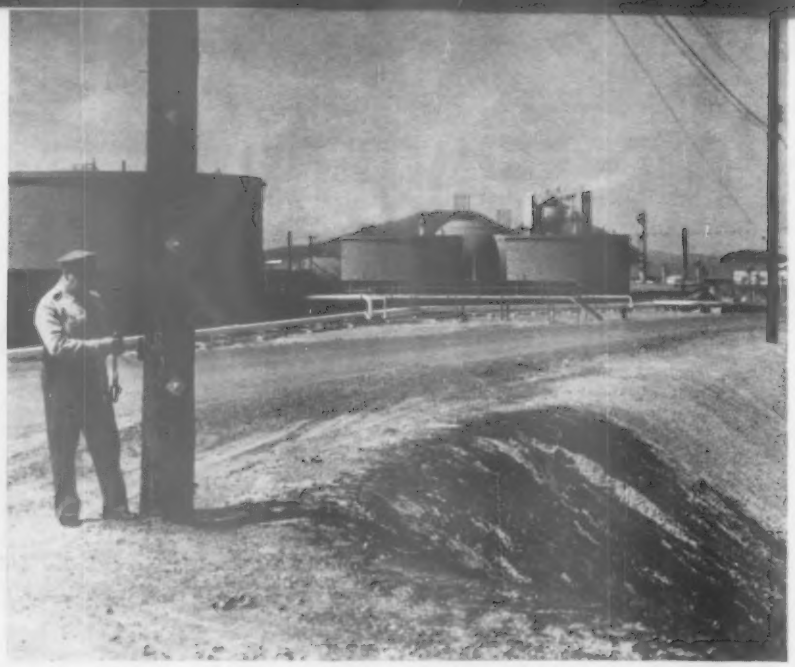
The Montague plant will use a newly developed electric arc process for cracking natural gas or petroleum byproducts into acetylene.

PETROCHEMICAL-ACETYLENE PRODUCERS

(Capacity in million pounds annually)

Company	Plant location	Status	Capacity
American Cyanamid	Avondale, La.	existing	100
Diamond Alkali	Deer Park, Tex.	late '61	35
Dow Chemical Co.	Freeport, Tex.	existing	8
Du Pont	Montague, Mich.	early '63	50
Monochem	Geismar, La.	late, '62	80
Monsanto	Texas City, Tex.	existing	80
Rohm & Haas	Deer Park, Tex.	existing	35
Tenneco	Houston Ship Channel	late '62	100
Union Carbide	Texas City, Tex.	existing	75
Wulff Process	Los Angeles, Calif.	existing	1
Total			564

INSTRUCTIONS are relayed from the main gave via short-wave radio to guard in patrol car somewhere on Shell's 800-acre site.



TANK-FARM PROTECTION is demonstrated here as a Pinkerton security guard rings his clock in a remote area of Shell's tank farm. Three uniformed and armed guards are on duty on each of three shifts, 7 days a week.

Plant security: do-it-yourself, or contract?

MUCH HAS BEEN in the news the past few years about refiners' experiences in contracting with outside companies for maintenance, cleaning, and turnaround crews. Security forces have come in for their share of this business too.

Typical among refineries which contract their security service is Shell Oil Co.'s 55,000-bbl. plant at Anacortes, Wash. Pinkerton's National Detective Agency handles the service, as it does for several other refineries in the area.

Among the benefits of contracting, Shell officials cite the shucking of administrative headaches by letting a pro run the security. The details connected with running a company guard force are generally more time consuming than the affairs of many times that number of refinery employes. Someone must be responsible for maintaining schedules for day and night protection, plus keeping up with vacation schedules, absences, rules infractions, etc.

The uniformed guard force spots fire and safety hazards, enforces company regulations, supervises traffic and parking, and polices the installation.

To handle this program at Anacortes' 800-acre site calls for nine guards a day—three uniformed and armed guards on each of three shifts, 7 days a week. Ordinarily the ranking guard on shift remains at the refinery entrance checking company personnel, vehicles, and visitors in and out.

The other two guards spend most of their time on patrol. One is on foot in the immediate refinery area. The other, in a radio-equipped car, checks the tank farms, perimeter fencing, wharf, and the tank-truck and tank-car loading areas.

Cato now operating in new plant

BACK IN OPERATION, after being nearly destroyed by fire last year, Cato Oil & Grease Co., Oklahoma City, has moved into its new 66,000-sq. ft. blending plant. The firm, custom blenders of oils, has over 200 products in its line which are shipped throughout the country. Instead of the old "paddle" method of blending, in its new plant Cato has installed outboard-motor propellers, powered by electric motors, to mix the oils.

Fig. 1.

Twin-arch pipeline span connected together by cross-struts is a . . .

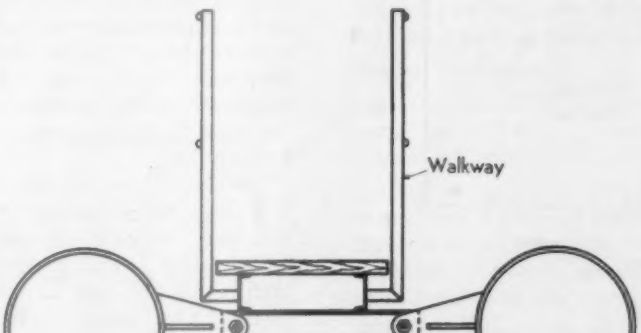
New approach to pipeline crossings

BY WALTER E. RILEY
Consulting Engineer
Phoenix, Ariz.

AN ECONOMICAL solution to the pipeline-crossing problem may be achieved by providing a twin-arch pipeline span, in which two inclined arched structures are located side by side and connected together by cross-struts to provide lateral stability. This will also permit relative displacement between the two arches in the vertical direction. Since relative displacement between the two arches is permitted, the two arches may be employed to carry substances having different weights or temperatures without creating excessive stresses.

Each arch is solely supported by the abutments at end so that it is free to rise or lower with changes in temperature without requiring expansion joints or offset turns. Thus by forming the pipe into the shape of an arch, the great structural qualities of the arch are incorporated without impairing the bursting strength of the pipe.

EDITOR'S NOTE: This proposal for a pipeline crossing with an unsupported span is presented because of its interesting design possibilities. We would like to have comments from our readers. Some of these, we hope, might lead to our arranging with them for articles on their own experience with long unsupported spans at pipeline crossings.

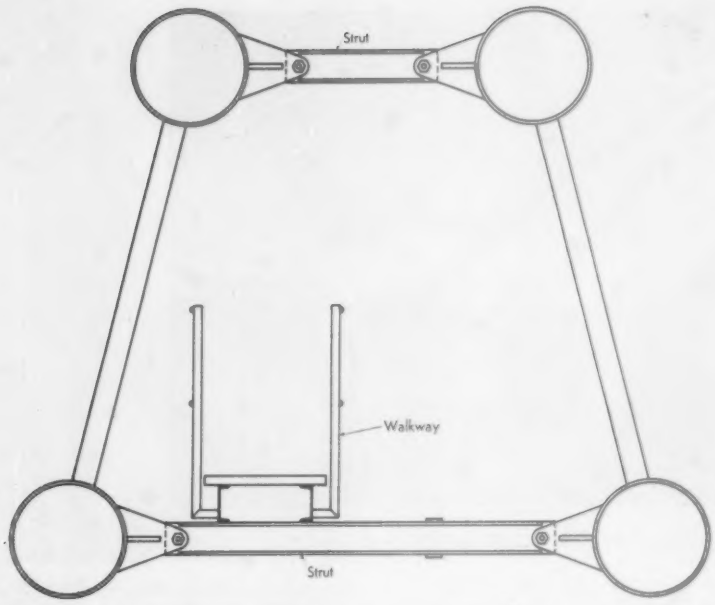


TWIN-ARCH CROSS-SECTION, showing walkway which can be installed if desired. Fig. 2.

QUAD ARCH can be used when spans become very long. Fig. 3.

Current practice. Pipeline crossings are commonly made by burying line in river bottom, tunneling under obstructions, and using special types of suspension bridges. The first method is sometimes sensitive to scour, the second to corrosion, and the third requires a high capital investment. Except for relatively short beam spans, American practice limits the use of the pipe to a pressure vessel. It is not usually incorporated into a self-supporting structural system as proposed here.

How it works. Fig. 1 shows a model of a proposed 250-ft. cross-



QUAD ARCH in cross-section. Spans of more than 1,000 ft. are possible. Fig. 4.

ing in the western part of the United States. Note the clean functional appearance. Fig. 2 is the cross-section with walkway, if desired. Each abutment has a hole in it which accommodates an elbow that is welded to the arch and to the line. If only one line is needed, then the elbows of adjacent arch are blanked off until line is looped, at which time they are welded to the new line.

When spans become very large, a quad arch is used. In this case, each of the two arches is composed of two pipes both of which lie in the inclined plane of the arch. Fig. 3 is an elevation of a quad arch and Fig. 4 the cross-section. Designs are possible for spans of 1,000 ft. and more.

Vibration Control

It is well known that conventional pipeline suspension bridges are sometimes susceptible to vibrations because of their relatively light weight.

In controlling unwanted vibration in a structure, the three most important factors are the natural frequency of the structure, the magnitude and frequency of the exciting force, and the internal dampening capacity of the structure. The natural frequency of a structure is defined as that frequency at which the structure vibrates when a load is applied to the structure and suddenly released.

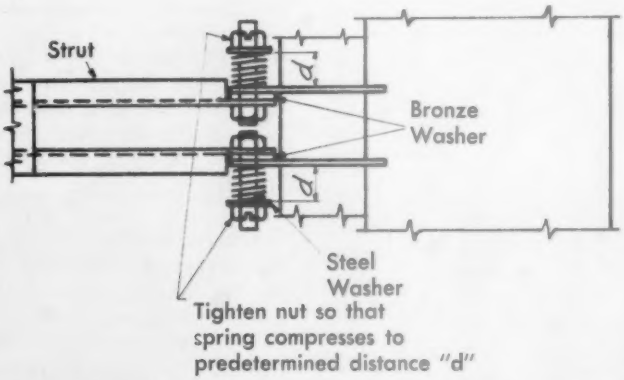
If a load is periodically applied to a structure, the number of times per second the load is applied is called the frequency of the exciting force. The internal dampening capacity of a structure is defined as the amount of energy absorbed in vibrating.

As long as the dampening capacity of a structure is greater than the energy put into it by a pulsating force, no harm is done; but if the dampening capacity is too small, the structure may resonate, i.e. vibrate at its natural frequency until it is destroyed. An example of this phenomenon was the failure of the suspension bridge at Tacoma, Wash., popularly called "Galloping Gertie."

Pulsating forces. Structures, such as the twin arch, may be subjected to pulsating forces in several different ways. For example, a walkway may be provided on the structure, and a group of men walking across it in a cadence equal to the natural frequency of the span can create resonance, if the internal dampening capacity of the span is not sufficiently large.

Another source of pulsating force is a steady wind blowing across the structure. When a horizontal wind blows across a pipe, whirls are created on the top and bottom of the pipe. These whirls detach themselves periodically depending on the velocity of the wind. When a whirl is detached, a definite force is exerted on the pipe.

Since the whirls leave alternately, pulsating forces are applied to the pipe. If the frequency of these forces coincides with the natural frequency of the structure, and if the internal dampening capacity of the structure is exceeded by the energy applied by the wind, objectionable



STRUT CONNECTION allows deflection and provides dampening capacity. Fig. 5.

DISPLACEMENT DIAGRAM shows that strut construction provides for internal dampening. Fig. 6.

vibration of the structure will ultimately result.

Dampening capacity. Fig. 5 is an apparatus for adjusting the dampening capacity of the twin-arch pipeline so that the dampening capacity can be made larger than any pulsating force which may normally be applied to the structure. The apparatus includes means for adjusting the internal friction in the pivots which permit the arched pipes to move vertically with respect to each other.

By making the friction of the pivots sufficiently large, the span has adequate internal dampening capacity to overcome any pulsating force which normally may be encountered, and yet the pipes are still capable of moving vertically with respect to each other.

The distance between the arched pipes varies along the longitudinal direction of the pipes, thus preventing wind whirls on the leeward arch from coinciding with those on the windward arch. With this arrangement the arches cannot vibrate in unison, and therefore the arches are not deflected together, thereby permitting the friction in the pivots of the connecting struts to absorb the applied energy.

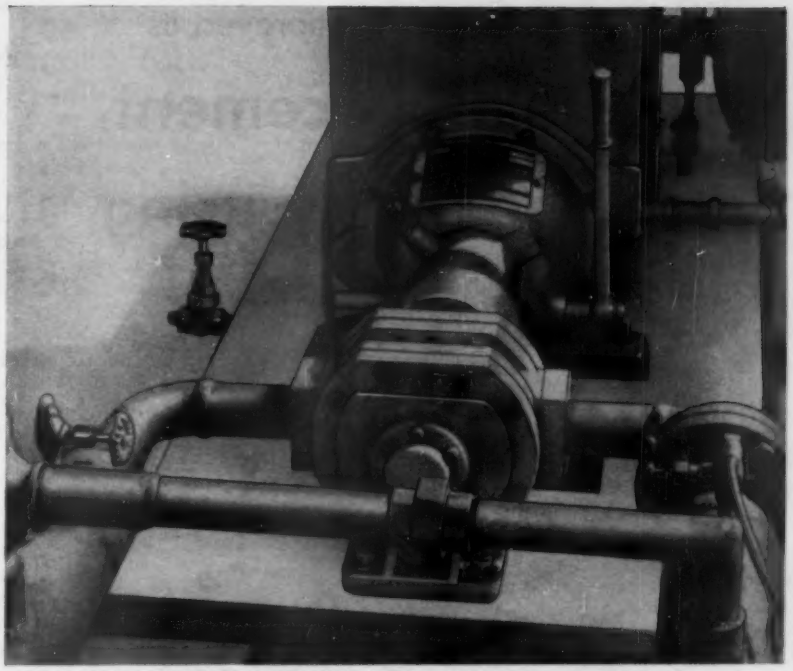
Fig. 6 shows cross-section with pipes in original position and in deflected position as indicated by dotted lines. Note for any deflection "Y," struts rotate on the pivots an angle "A." If force is thus applied to the contact surface, a definite frictional resistance must be overcome for ends of strut to rotate, thus furnishing internal dampening.

Foreign Structure

The American pipeline industry has hesitated to use this type of pipeline span, in spite of its low cost, because of the pipe acting as a structural member as well as a pressure vessel. However, the Lane Cove River span near Sydney, Australia, is an overseas application designed by Australian Gas & Light Co.[1] The arches are 18-in. pipe and span about 216 ft. The horizontal struts are 12-in. pipe welded to the 18-in. pipe. This perhaps does not allow for enough differential movement, but it is a move in the right direction.

Reference

1. Engineering News Record, July 16, 1959, pp. 28-29.



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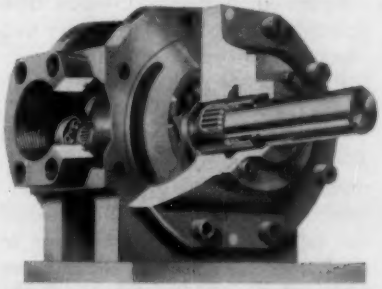

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Here's how Gulf improved its

Formation cement squeezes by using low-water-loss cements

BY H. J. BEACH, T. B. O'BRIEN, AND W. C. GOINS, JR.
Gulf Oil Corp., Houston

PART 2

IN THE FIRST part of this article you read how Gulf formulates the low-water-loss cement which has greatly improved the success of the company's squeeze cement jobs.

Just as important as the formulation of the cement is the way in which it is squeezed in the well. Generally, the process is one of pumping in small volumes, then waiting for a time before pumping in a little more. This process first builds up a dehydrated cement cake in the perforations which readily accept fluid. Then, as these are plugged, pressure naturally goes up and the more resistant perforations begin to take fluid.

But, because of the low water loss of the slurry, the main body of slurry in the casing does not become dehydrated; it does not block flow through the casing. The slurry can reach all perforations. Thus, chances for success are far greater than with older, high-fluid-loss cements.

When squeeze pressure has gone as high as needed, the slurry remaining in the casing can be reversed out. It need not be drilled out later. Result is a big saving in rig time needed to pull the squeeze tool and run a bit.

Equipment needed. To do the job we want requires careful operation and good control. Thus, we must have proper tools including a retrievable packer with drillable tail pipe, preferably of aluminum. For short perforated intervals, the tail pipe can be long enough that the packer stays out of the perforations while washing. In intervals longer than 100 ft., we make it a practice to wash through the packer and a short length of tail pipe.

We also use an attachment on the lower end of the tail pipe to spread the washing action. Such a device prevents the need for scraping the casing afterwards. During the squeeze, the tail-pipe end is usually set a few feet above the highest perforation.

Batch mixing is essential for good blending of small quantities of cement. This requires a small (10 to 30-bbl.) blender. Additives can be dissolved in fresh water before mixing the cement. Or, they may be dry-blended with the cement. If dissolved in the mixing water, the retarder should be added first; this will aid dissolving the fluid-loss agent. The entire mixing need not exceed 30 minutes.

Displacing, pumping. Let us take the case of squeezing sands with normal or higher bottom-hole pressure and with mud in the hole. Cement is circulated to bottom with the packer lowered. Then, the leading water spacer is used to flush mud from the perforated interval. The packer is then raised and set to trap a portion of the water spacer in the annulus.

If the drilling fluid is water, it isn't necessary to flush the interval. The packer may be set to squeeze before circulating cement to bottom.

The slurry is pumped into the formation slowly until pressure develops at the surface or until a barrel or so of cement is out the perforations. At this time, you should begin alternate pumping and hesitation. The appendix describes a typical field job with its slow pumping rates. It would be well to study carefully the frequency and extent of hesitation periods.

When squeeze pressure is slow to develop or bleeds off, you can compensate by progressively slower pumping rates and longer hesitation periods until squeeze pressure no longer bleeds off. This practice requires patience and confidence in the slurry.

Backflow, washing. When the final pressure you want holds for about 15 minutes without pumping, bleed the tubing to check backflow. Backflow usually is a barrel or less of fluid and is the result of tubing contraction. However, any air trapped in the tubing expands when pressure is released and can return enough fluid to be mistaken for formation backflow. Our experience is that true backflow seldom occurs. If it does, additional squeezing is necessary.

If there is no backflow, the packer is released and cement in the tubing reversed without holding back pressure. Do this cautiously so reversing pressure does not exceed final squeeze pressure. If there is much slurry to be reversed, the pressure imbalance between the tubing and the casing usually favors the tubing. For this reason, use only enough casing pressure to start slow reversal. As slurry returns to the surface, imbalance will reduce, permitting faster reversal at lower surface pressure.

After slurry is reversed out, lower the tail pipe and packer slowly and reverse wash the perforated interval. Be careful not to set too much weight on the tail pipe. After washing, we make it a practice to pull back up to the original packer seat and apply a low pressure to the

This is the second of two parts; the first appeared June 12, 1961. Both installments are from a paper titled, "The Role of Filtration in Cement Squeezing," presented by the same authors to the 1961 spring meeting of the API Division of Production's Southern District, Shreveport.

Typical squeeze job, Baxterville, Miss.

This well had been making water from perforations at 8,786-91, 8,813-20, 8,838-43, and 8,860-80 ft. in 7-in. casing. Working with 2⅞-in. tubing, a full-bore, retrievable cementer was set at 8,720 ft. Connected to the packer by a safety tension joint was 65 ft. of aluminum tail pipe with a flange attached to the end at 8,785 ft. The cement slurry consisted of 100 sacks of slow-set cement and was mixed at 16.0-lb. per gal. with 1.5% sulfonated aromatic compound. After testing the tubing with 4,000-lb. pressure:

5:45 p.m.—Formation taking 9.4 lb. per gal. salt water at 4 bbl. per minute. Set tool.
6:35 p.m.—Mixed additive and cement in batch blender.
8:03 p.m.—Put 1,200 psi. on annulus. Pumped 15 bbl. fresh water into tubing at 3 to 4 bbl. per minute.
8:08 p.m.—Pumped 21 bbl. cement into tubing at 3 bbl. per minute.
8:15 p.m.—Pumped 5 bbl. fresh water into tubing.
8:17 p.m.—Displaced cement with salt water.
8:26 p.m.—Cement at tool. Pumped at 2 bbl. per minute.
8:28 p.m.—6 bbl. cement out of tubing, pressure zero.
8:30 p.m.—9 bbl. cement out of tubing, slowed pumping rate to ½ bbl. per minute.
8:32 p.m.—10 bbl. cement out.
8:33 p.m.—11 bbl. cement out.
8:35 p.m.—Pressure 250 psi., shut down pump.
8:36 p.m.—Pumped ¼ bbl. per minute, 11½ bbl. cement out.
8:38 p.m.—12 bbl. cement out, pressure 300 psi.
8:40 p.m.—13 bbl. cement out, pressure 300 psi.
8:44 p.m.—14 bbl. cement out, pressure 1,000 psi., shut pump down, pressure bled to 200 psi. in 2 minutes.
8:46 p.m.—Resumed pumping at ¼ bbl. per minute.
8:50 p.m.—15 bbl. out, pressure, 1,200 psi.
8:53 p.m.—16 bbl. out, pressure 1,400 psi.
8:54 p.m.—Shut down pump. Pressure bled to 500 psi. in 6 minutes.
9:00 p.m.—Put out ½ bbl. cement very slowly (⅛ bbl. per minute).
9:02 p.m.—17 bbl. out, pressure 1,700 psi., shut pump down; pressure bled to 700 psi. in 5 minutes.
9:07 p.m.—Pumped ½ bbl. very slowly.
9:08 p.m.—17.5 bbl. out, pressure 2,100 psi., shut pump down, pressure dropped to 1,300 psi. in 6 minutes.
9:14 p.m.—Pumped ¼ bbl. very slowly, pressure 2,500 psi., shut pump down, pressure dropped to 2,200 psi. in 6 minutes.
9:20 p.m.—Pumped ⅛ bbl. very slowly.
9:21 p.m.—Pressure 2,500 psi., shut pump down, no drop in 14 minutes.
9:35 p.m.—Bled pressure off tubing very slowly, no flowback.
9:40 p.m.—Reversed 3⅛ bbl. cement.
9:57 p.m.—Surface returns on cement.
10:30 p.m.—Washed down to 8,834 ft. at 2 ft. per minute. Pulled three strands very slowly.
11:30 p.m.—Closed well in with 1,000 psi.

Following Day:

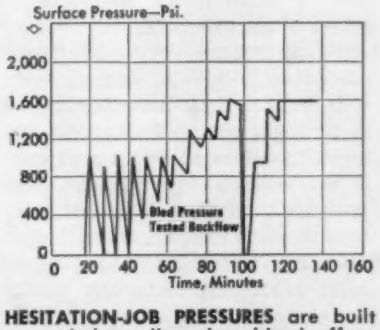
11:00 a.m.—Began swabbing.
4:00 p.m.—Swabbed to 6,700 ft., let set 1 hour.
5:00 p.m.—Tagged water at 6,700 ft., no rise; dry test.

Thus, a 94-ft. perforated interval was successfully squeezed in one stage, and no time was lost in drilling cement.

squeeze. Then, the seals can be tested 12 to 16 hours later.

Low-pressure wells. To squeeze formations with pressure so low the well cannot be circulated, set the packer and pump only enough slurry into the tubing or drill pipe to balance formation pressure. Stop the pump, close the tubing at the surface, and allow the fall of the slurry to come to equilibrium. After about 15 minutes, resume pumping the remaining slurry (or displacement fluid) a barrel or two at a time, hesitating long enough in between to encourage cake building.

As the tubing begins to fill, each barrel of fluid adds as much as 200 psi. on the cake which has started developing. If the new slurry being added continues falling in the tubing, longer waits between pumping are required. You can detect the fall in the tubing with a vacuum gage or by the inrush of air when you open a tubing valve.



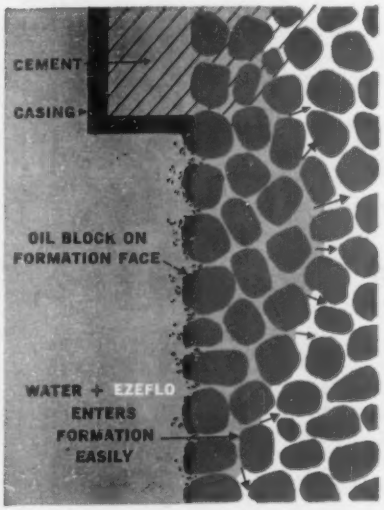
HESITATION-JOB PRESSURES are built up and then allowed to bleed off as the pumps are stripped. A little cement is pumped in, then there is a wait before more is pumped. Gradually, the injection pressure and the bleedoff pressures get higher. Finally, top squeeze pressure is reached and there is little bleedoff. Backflow test makes sure cement cake doesn't flow back into the well.

After the tubing has filled, you can control the process with a pressure gage. The remainder of the job to final pressure consists of progressively slower pumping between progressively longer shutdown periods. You can assume the cake is compacting adequately when the pressure holds with only slight bleedoff during pump hesitation. If the slurry is fluid, and nongelling you can correctly interpret pressure-gage behavior which is the key to the technique.

On such low-pressure formations, starting to reverse out slowly prevents breakdown of the squeeze and is even more important than in normal-pressure zones.

Fig 1 shows growth and decay of pressure during this type of squeeze. The example is drawn from squeezing a 62-ft. perforated interval in a well in Jackson County, Colorado.

new agent to lower water injection pressures



A new agent has been developed by Dowell to lower water injection pressures required to pump fluids into disposal or secondary recovery injection wells. The new chemical agent, called Ezeflo*, is a low-pour-point, water-soluble, nonionic surfactant. Ezeflo lowers the surface tension of water and the interfacial tension between water and oil. It also acts as a detergent for removing oil particles blocking water injection; thus reducing the pressure required for a given rate of flow. A major advantage of Ezeflo is its ease of handling. Ezeflo dissolves in water much more readily than many similar products. This assures good distribution and increases the efficiency of the solution. The low pour-point of Ezeflo (—33°F) makes the product usable in cold climates. Ezeflo is packaged 50 gallons to the drum and is available from any Dowell station.

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For the first 70 minutes the operator was content to work the pressure no higher than 1,000 lb. During this time the pressure drops on pump shutdown gradually diminished, signifying that the cake was building and compacting in the voids. Each pressure peak indicates a shutdown. Only 12 sacks of cement were pumped into the perforations during the squeeze. The calculated bottom-hole pressure at the time of final pressure was 5,200 psi.

Final Pressure

What should final squeeze pressure be? In any event, it should be expressed as bottom-hole pressure. There is no logical basis for squeezing wells to some set surface pressure with no regard to the fluid-column pressure. In the past, many have thought of low-fluid-loss cements in association with the low-pressure squeezes of permanent-type well completion. Let us emphasize that "low-fluid-loss squeeze cementing" is not necessarily "low-pressure squeezing."

It is usually possible to attain quite high squeeze pressure by the methods we describe. Still, we believe it is useless to blindly seek some arbitrarily set final pressure and pay for this pressure by repeatedly sacrificing squeeze stages. The final pressures should be selected through study of well conditions, remembering that effective cake placement and not high pressure is the primary objective. When clean perforations are squeezed, final bottom-hole pressure need not be more than 1,000 psi. above "pump-in" or "breakdown" pressure. Strength of the seal will increase as the cake sets.

Where perforations are filled with mud cake, a high squeeze pressure is essential to get a successful job in a single stage. The mud plugs must be displaced by cement cake if the well is to withstand high pressure later. This is possible only by following the process of hesitation pumping, patiently forming cement cake in perforations readily accepting it. Then, enough pressure can be built to force cement into the mud-plugged holes.

Usually, final squeeze pressure on mud-filled perforations should be as high as test or well pressures.

Problem wells. In some wells, formation pressure is low or the zone is easily fractured. Other wells have cavities or low matrix permeability. Such zones do not readily allow dehydration. As a result, it is tedious or impossible to attain a high final squeeze pressure. Low-pressure limestone and dolomite reservoirs and shale are examples of such formations. When squeezing such formations, it is often necessary to be satisfied with a low, final squeeze pressure of about 1,000 psi. above pump-in pressure.

If a stage builds and holds no squeeze pressure, allow some slurry to remain, set, and be drilled out. This will make success of the next stage more likely.

Usually, you can build some squeeze pressure. If you watch carefully the pressures during squeezing, you can often detect when cake has plugged the openings. For instance, this is indicated when only a few strokes of the pump following a hesitation period cause an immediate pressure rise of 500 to 1,000 psi. and the pressure does not bleed off. The pressure at this point can be accepted as the final squeeze pressure. If you attempt to attain high pressure, you may only move cake through the openings and break down the squeeze. If this is allowed to occur, it is reasonable to rebuild pressure until cake is again placed firmly and settle for a lower squeeze pressure.

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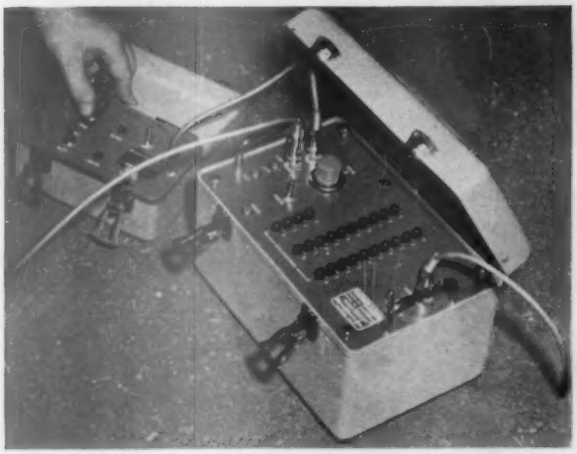
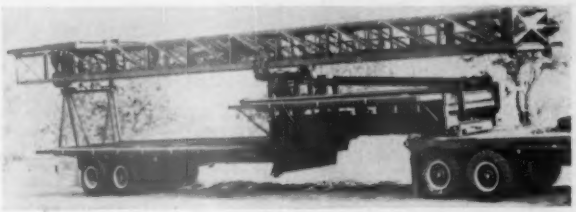
What's NEW . . . in equipment



Blaster measures rock depth

A COMPACT BLASTING DEVICE has been brought out that promises to be helpful in construction work and geophysical exploration. The blaster is lightweight and measures only 4 by 7 in. As illustrated, it is being used with a seismic timer to determine bed-rock depth. The device is battery-operated and a capacitor-discharge type. Components include a built-in circuit tester, ready light, and a positive, three-switch safety feature. Source: **DynaMetric, Inc.**, 2955 E. Colorado Blvd., Pasadena, Calif., U.S.A.



Haul drill equipment in one load

A 96-FT. TRAILER-MOUNTED MAST and substructure assembly has been developed which is claimed to permit drillers to haul all essential drilling equipment in one load. Called a Crusader, the unit is designed to make it readily adaptable for medium-depth drilling with 4½-in. pipe, for slim-hole drilling, or for workover and service operations.

The substructure trailer assembly can be separated in front of the mast to provide a suitable workover unit for small offshore platforms. Instead of hydraulic raising devices, the unit is designed so the drawworks engine is used to roll the mast to the upright position. The traveling block, through the use of sling lines, is then used to raise and vertically telescope the mast. The guy lines are internal.

The unit comes in three sizes—125,000, 160,000, and 200,000-lb. static hook-load capacities with six lines to the traveling block. Measuring 54 ft. long, all models are within an 8-ft. road width. Source: **Fox Equipment & Derrick Co.**, 4712 Selkirk Dr., Fort Worth 9, Tex., U.S.A.

●

Control valves

Bubbletight shutoff is provided by a new line of control and line valves recently put on the market, tradenamed Spanseal. Other features cited for the valves include versatile internal-flow configurations, low shifting force, small linear movement, adaptability to a variety of pilot attachments, and chemical compatibility with natural-gas and petroleum products.

The control valves are available for 1,500-psi. pneumatic and hydraulic service and a −40° to 250° F. temperature range. They are made up of three elements: the basic valve, a manifold block, and the operating attachments. The basic valve comes in four, three, and two-way, diverter and shuttle cycles. Attachments are available for low and high pressure, solenoid, manual, and cam operation.

The line valves are available for 1,200-psi. pneumatic and hydraulic service and a −40° to 250° F. temperature range. A unidirectional type with integral actuator, they are available in a straight shutoff cycle or as shutoff valve with a downstream vent for services requiring tight shut-off of upstream pressure while venting the downstream line. A handwheel is provided for auxiliary manual operation. The integral actuator is pressure-operated with spring return. Source: **Ledeen, Inc.**, 3350 N. Gilman Rd., El Monte, Calif., U.S.A.

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OIL AND GAS JOURNAL
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Basket to catch milling cuttings

A new drilling tool, called a Kirby Boot Jet Basket, can be used to catch milling cuttings when you mill out bridge plugs, cement retainers, and production packers. It can be run with the drill bit before diamond coring or drilling.

When the tool is positioned in the drilling string above the mill or bit, it creates a jetting action which is developed by recirculation of the drilling fluid through the boot sleeve. This jetting action creates a suction at the top of the boot which pulls cuttings from the return stream into the basket. The screen lets the fluid drain out and be recirculated downward through a venturi at the bottom of the tool. Cuttings are trapped in the basket.

The tool consists of three parts: an upper submandrel, cylindrical boot with an inner screen around the mandrel, and a lower jet sub. Interchangeable lower subs permit the tool to operate efficiently with a nonrestricted mill, standard bit, or with a restricted jet bit. Source: **K & G Oil Tool & Service Co., Inc.,** 2703 Sackett, Houston 19, Tex., U.S.A.

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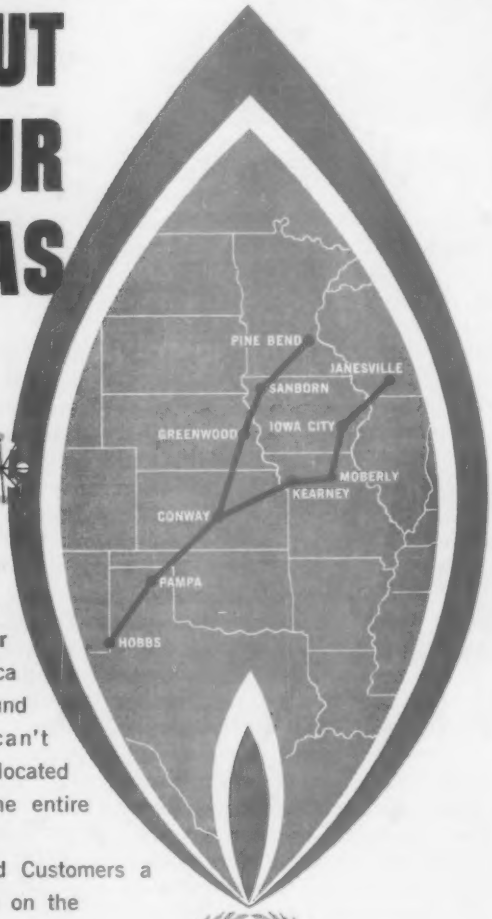

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Do your Distributors and Customers a favor — put your products on the M.A.P.* call —

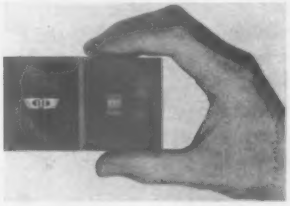
MID-AMERICA PIPELINE COMPANY

1437 SOUTH BOULDER • TULSA, OKLAHOMA

Switch protects oil-field pumping units

If fluid flow ceases in a pumping unit on which a new flow switch is installed, the switch shuts the pump down and so prevents bearing damage or overheating due to lack of fluid flow. The device can also be used to shut down the pump if flow becomes excessive.

The Model 3500S switch can also be installed as a flow alarm to indicate a change in flow conditions, activate an alarm system, or start a standby pumping unit. It consists of an actuating vane in the flow line mechanically linked to a magnetic plunger. The plunger operates a magnetically operated switch external to the fluid flow. The external switch is enclosed in an explosion-proof housing. **Ball Mfg. Co., Inc.,** P. O. Box 2275, Torrance, Calif., U.S.A.



Pocket-size calibration tester

Recording or indicating instruments can be tested in the field or laboratory with this pocket-size calibration tester, Model BH153. The instrument is a direct-reading, adjustable-voltage source that simulates the direct-current electrical output of transducers with a setting

PIONEERS IN EFFICIENT DESIGN

COBRA BITS

IN MUD OR AIR

Reed Cobra bits are just one example of the outstanding economies made possible by Reed's continuing program of research and development. These bits are setting phenomenal records all over the oil country in both mud and air drilling. For example—

On a West Texas well, drilling with mud below 12,000 feet, four Reed Cobra bits drilled 2,289 feet in 404½ hours. On an offset well it took 37 tooth bits to drill 2,172 feet in 558 hours. On another West Texas well a Cobra bit set an air drilling record of 3,644 feet in 103 hours.

In Pennsylvania, drilling with air, it is routine for one Reed Cobra bit to complete the hole from surface casing to TD. In this area total footage per Cobra bit regularly exceeds 7,000 feet.

Drilling with mud in East Texas in the tough Travis Peak formation Cobra bits consistently get runs up to 250 feet. Drilling with gas in Mississippi 10 Cobra bits drilled 6,850 feet in 358½ hours. In the same vicinity more than 10 times this number of tooth bits were required to drill the same footage with mud.

There is a Reed man near you. Let him give you the full story on Reed Cobra bits and the Reed Quality Line—tool joints, drill dollars and rock bits.

PENNSYLVANIA — 1 COBRA BIT, 8,352 FEET IN 134½ HOURS

WEST TEXAS — 1 COBRA BIT, 3,644 FEET IN 103 HOURS

FOUR CORNERS — 1 COBRA BIT, 4,102 FEET IN 134½ HOURS

MISSISSIPPI — 1 COBRA BIT, 1,317 FEET IN 51¾ HOURS

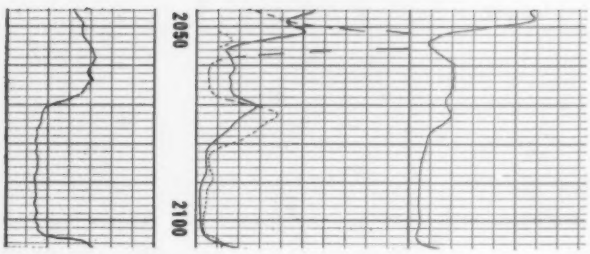
REED ROLLER BIT COMPANY

HOUSTON 1, TEXAS • Export Office: Time and Life Bldg., Suite 3744 Rockefeller Center, New York 20, N. Y.—Reed Roller Bit Company (Nederland) N. V., Roosevelstraat 6, Leiden—Reed Roller Bit Company, Ltd., 4431 6th St. S.E., Calgary, Alberta

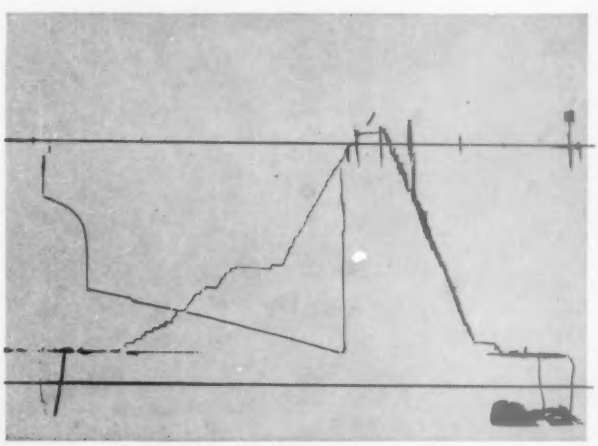
WHICH WELL WAS THE PRODUCER?

#2

WELL "C"

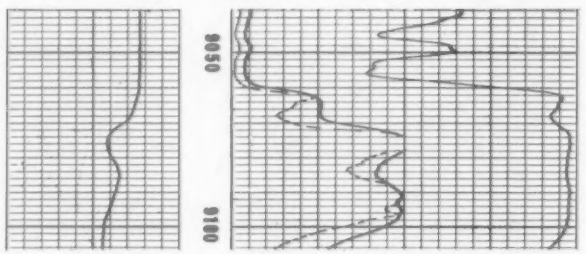


This rank wildcat was drilled to 6122'. Log analysis showed one interesting zone at interval 2068'-2080', and core analysis revealed 20% porosity with 70.5% fluid saturation (14.5% oil, 56.0% water). Both core analysis and logs indicated a transition at 2081'. Would you set casing on this well? Before reading further, study log and core information on well "D".

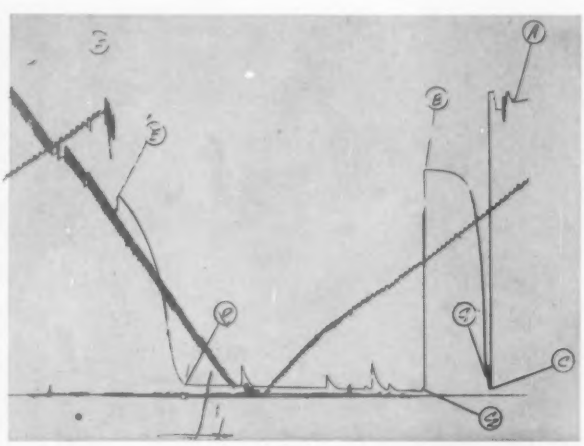


It was determined that much more conclusive data was needed before making a firm decision regarding completion of this well. Johnston Testers performed a selective zone test recovering 120' mud-cut oil, 1050' free oil and 40' salt water.

WELL "D"



Electric logs on this step-out well revealed the expected zone at interval 9066'-9092'. Log curves showed favorably. Analysis of cuttings showed an average porosity of 12% and 42% fluid saturation. Would you set casing on this well? Now study the drill stem test data on both Well "C" and Well "D" for the real answer.



Information obtained to this point showed favorably for a producer. However, a decision was made to get additional data prior to setting casing. Johnston Testers performed a 3-hour drill stem test recovering 300' of water and mud-cut water.

Well "C" became the producer flowing 90 barrels of pipeline oil daily. Well "D" is proof of the value of a Johnston drill stem test prior to setting casing. A decision based on logs and geological data alone could have been very costly. The operator of Well "D" stated that he was prepared to set 7" casing, perforate and treat the zone, and further, that the D.S.T. saved him approximately $15,000 to $20,000. You can save thousands of dollars, too! Call Johnston Testers on your next well.

JOHNSTON TESTERS

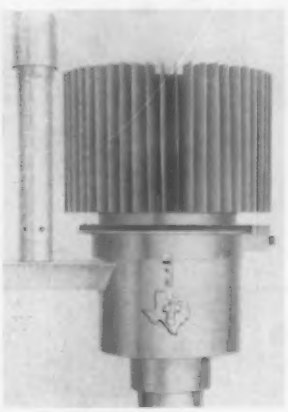
Houston, Texas • Calgary, Canada

accuracy of 0.05%, the maker says. Instruments operating in the millivolt or microvolt range can be tested.

The test device is mated to the curve of any direct-current transducer in either direct or indirect terms of reference.

Measuring 12 ft. long, the scale can be graduated in several ranges or in a single range with up to 1,000 scale divisions. The tester consists of a potentiometer of infinite resolution, with a bridge network supplied with 115-volt, a.c. 60 or 400-cycle power. It measures 4 by 2¾ by 2¼ in. and weighs about 8 oz. Source: **Howell Instruments, Inc.,** 3479 W. Vickery Blvd., Fort Worth 7, Tex., U.S.A.

•



Eight-watt thermoelectric generator

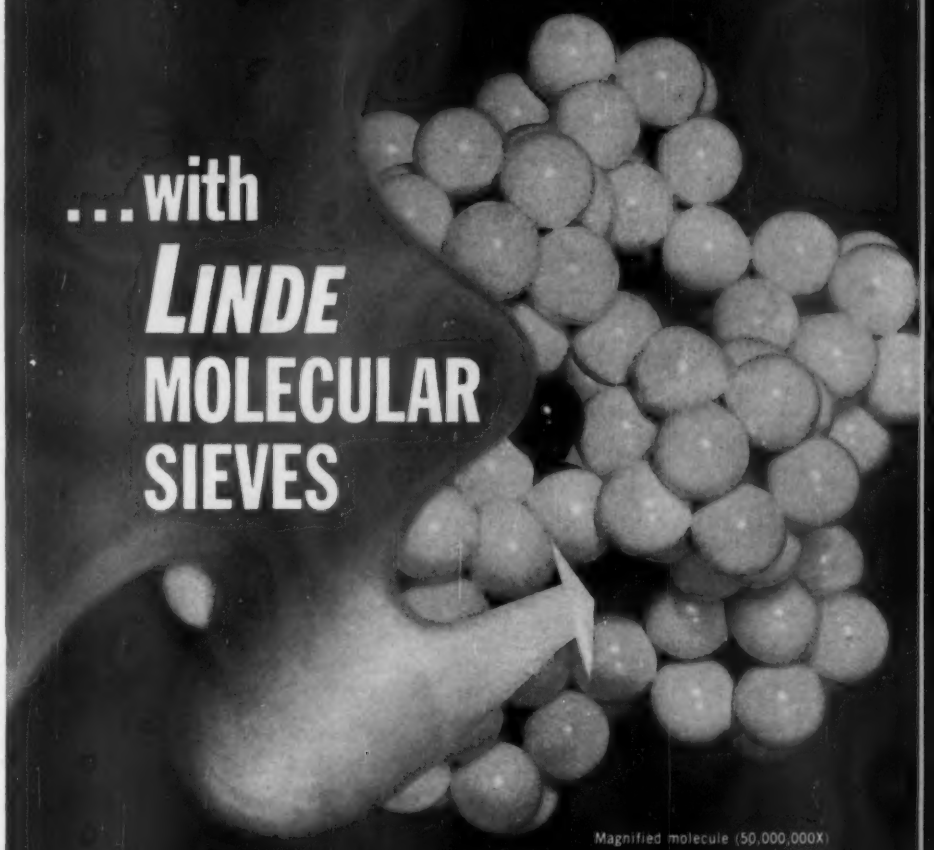
A power source for remote locations on pipelines or at remote oil and gas-production facilities is offered by an 8-watt thermoelectric generator which is now on the market. You can operate it from natural gas, propane, or butane. It's designed for remote unattended field instrumentation. Potential uses include the operation of valves on transmission lines and production equipment and for the cathodic protection of pipelines and structures.

Even during continual exposure to the elements, the unit will operate efficiently, the maker reports. No housing or special enclosure is needed. The generator burner is designed so wind won't blow it out.

Besides the fuels mentioned, the generator can be operated with any other combustible fuel, as well as waste heat, steam, or solar heat. It weighs 65 lb. and measures 12 in.

Real adsorption costs are lower

...with LINDE MOLECULAR SIEVES



Magnified molecule (50,000,000X) of the original synthetic zeolite

Important savings achieved by increasing throughput of existing equipment

The use of LINDE Molecular Sieves provides the most economical approach to most adsorption problems.

They permit the cost-reducing benefits of automatic, non-corrosive single-stage systems . . . provide increases in throughput with little or no additional capital expenditure.

LINDE Molecular Sieves are designed for long service life and low-maintenance cyclic processing . . . allowing years of operation involving thousands of reactivations . . . without replacement of beds.

For details, write Dept. O-6, Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York. In Canada: Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

Linde MOLECULAR SIEVES
"The Original Synthetic Zeolite"
Patented

UNION CARBIDE

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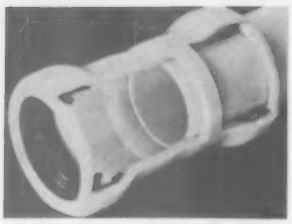
wide and 17 in. high. Source: **Texas Instruments, Inc.**, P. O. Box 6027, Houston 6, Tex., U.S.A.

●

Couplings for pipe put in without tools

Gas and water mains made of polyvinyl chloride can be coupled quickly without tools with a hard PVC coupling recently developed by a Netherlands manufacturer.

The coupling consists of two



U-shaped rib-profiled rubber rings which act as seals. The coupling comes for pipe sizes from 2½ to 4½ in. Source: **Polva-Nederland N. V.**, Enkhuizen, the Netherlands, or C/o Netherlands Trade Commission, 10 Rockefeller Plaza, New York 20, N. Y., U.S.A.

●

For slurries: a new control valve that drains itself

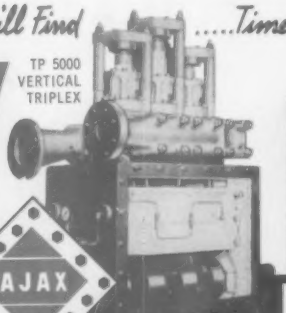
When a new control valve for slurries and for systems which must be purged is installed so flow is over the plug, ducts conduct any trapped fluid between the plug and the valve body down the sides of the plug.

Where Service is at a Minimum You'll Find .....Time Has Proved You Can Trust

AJAX VALUE and AJAX EQUIPMENT

AJAX PUMPS

TP 5000 VERTICAL TRIPLEX



AJAX OILFIELD AND INDUSTRIAL PUMPS

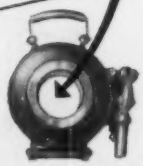
AJAX IRON WORKS CORRY, PENNSYLVANIA

Oil Field Distributors

- The National Supply Co. — Pittsburgh, Pennsylvania
- Bethlehem Steel Co. — Supply Division, Tulsa, Oklahoma
- Mid-Continent Supply Co. — Fort Worth, Texas

45 HANDY HYDRAULIC HELPMATES for OIL FIELD MAINTENANCE

BOTH HAVE THE FAMOUS "SIMPLEX" CENTER-HOLE FEATURE



Pull or push is right through the hole in the center of the ram which provides its own back-up . . . Simplifies rigging, eliminates torque, makes jobs 6 times faster and easier.

SIMPLEX "RE-MO-TROL" HYDRAULIC JACKS and PULLERS

For heavy-duty gear, sleeve and cylinder liner pulling; slush pump repair; pipe and culvert pushing; heavy rigging; leveling and lifting jobs of all kinds.

39 models, 10 to 300 ton capacities, remote controlled hand or powered pumps.

SIMPLEX "JENNY" HYDRAULIC PULLERS (Self-Contained)

Remove and install bearings, sleeves, bushings, liners, gears, pulleys, pinions, pins, on all kinds of machinery and equipment.

6 models, 30 to 100 ton capacities, single and double pump types.

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READER SERVICE DEPARTMENT
THE OIL AND GAS JOURNAL
Box 1260 Tulsa, Oklahoma

The plug is designed to completely drain its entire surface. All surfaces slope downstream, even if the valve is mounted in a level horizontal position, the maker says.

The valve comes in three types of body designs: globe, angle, and three-way. Connections may be ASA 300-lb. screwed in ½ to 2-in. sizes or ASA 150-lb. or 300-lb. flanged in sizes from ½ to 6 in. Operation may be pneumatic, electropneumatic, electrohydraulic, or cylinder and manual handwheel. Source: **Annin Co.,** 1040 S. Vail Ave., Montebello, Calif., U.S.A.

Valve with cross-type body simplifies tank hookups

A separate valve and cross are not needed to hook up tanks when a new tank valve is used. Its cross-type body design replaces the pipe tee normally required for tank hookup. Another feature of the valve is that it is designed to prevent water entrapment and subsequent freezing which can occur with vertically mounted valves.

Made in three sizes, 2, 3, and 4 in., the valve offers a wide choice of connection sizes and types. All internal components may be easily replaced without taking the valve body from the line.

The PV valve has a malleable iron body, stainless-steel internal components, and a stainless-steel plug with molded-in Buna-N rubber. The body cover is a nitrorubber compound. Connections for the valve may be grooved or threaded. Source: **Instruments, Inc.,** P. O. Box 556, Tulsa, Okla., U.S.A.

LINDE Molecular Sieves for MAXIMUM ADSORPTION CAPACITY

Three versatile grades give greater capacity, proficiency, and effectiveness

These LINDE-developed desiccants have proved more efficient over a wider range of applications than other commercial adsorbents.

Whether your process is drying, sweetening, purification, separation, recovery, or static desiccation, LINDE Molecular Sieves are capable of performing in accordance with the most rigid process specifications.

These unique materials—by means of their superior adsorption efficiency—perform tasks never before accomplished in many of these operations.

For details, write Dept. O-6, Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York. In Canada: Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

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Linde MOLECULAR SIEVES
The Original Synthetic Zeolite
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UNION CARBIDE

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Target SAVINGS THRU QUALITY FITTINGS

WRITE FOR NEW FITTINGS BULLETIN
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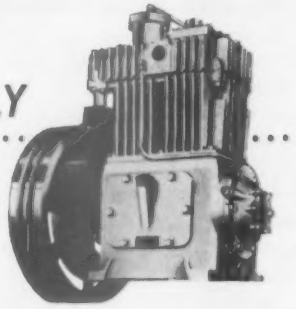

More than a hundred Quincy Authorized Service Depots stand ready to see to it that your Quincy Compressor delivers the long, reliable performance for which it was designed.

Each technician is a skilled, conscientious expert who makes sure every part is functioning perfectly when he checks your compressor. He also knows the importance of promptness in answering your call for assistance. Quality engineering and nationwide service go hand in hand to make a Quincy Compressor your best buy.

Models for all oil field and diesel applications from 1 to 90 CFM. Write Dept. OG1260 for free catalog.

QUINCY COMPRESSOR CO., Quincy, Ill.
Makers of the World's Finest Air Compressors

Combination pipe coating, primer

An asphalt coating has been combined with a primer to make a coating system for pipelines which the manufacturer claims offers a way to reduce pipeline maintenance costs as well as the electrical power costs where cathodic protection is used. The combination of the primer, 5-A-60, and coating, E-120-A, is designed to overcome the problems of both disbonding and excessive power costs on underground transmission lines where the pipe coating is supplemented by cathodic protection. Source: **Lion Oil Co.**, El Dorado, Ark., U.S.A.

●

New TV system lets you see what's inside a pipeline

A complete television system for the inspection of wells, oil and gas lines, and tanks is now on the market. The system is watertight and comes complete with an enclosed lighting system, from 500 to 1,100 ft. of cable, and a generator. It's capable of being pulled through pipelines with diameter from 4 to 48 in.

Completely self-cooled and capable of continual use, the Inspectoline TV system can show the inside of a pipe clearly on the monitor as the camera is pulled through the pipe. Snapshots, moving pictures, or recordings on video tape can be made as the camera is pulled through the pipe. These will permit future reference and appraisal of the pipe conditions. From the length of the cable in the pipe, the operator can tell the exact location of

Magnified molecule (50,000,000X) of the original synthetic zeolite

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Whatever your problems in separation, LINDE will consult and advise to solve them

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LINDE adsorption technicians are constantly on field duty, ready to serve you. Fundamental research, product improvement, and process development facilities support them . . . and are your assurance of continuing access to the most advanced ideas in adsorption.

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—J. K. Butler

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7440 CHOCOLATE BAYOU ROAD -- P. O. BOX 14291
HOUSTON 21, TEXAS
August 31, 1960

Mr. Gordon P. Street, President
The Wheland Company
Chattanooga, Tennessee

Dear Mr. Street:

Our Wheland Planetary Pump is giving us increased penetration and good savings on bits. We know from more than 18 months of constant operation on 10,000 Ft. wells that our savings are substantial.

We have kept an accurate record on operating costs and all maintenance costs and are especially impressed by the low cost of fluid end expendables. The HP-16000 Pump has constantly operated near its rated capacity on more than 200,000 feet of hole in the Texas Gulf Coast Area.

We are now operating Wheland HP-18000, HP-14000, and HP-16000 Pumps and are glad to recommend them. Your new HP-16000 Pump design is a great step forward with your planetary gears, big bearings and cylindrical crossheads.

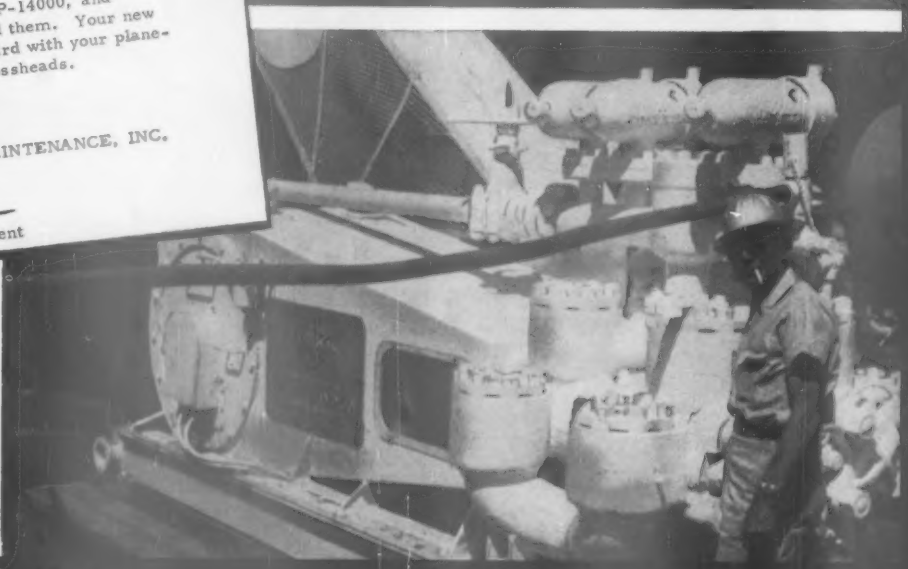
Yours very truly,

OIL PRODUCTION MAINTENANCE, INC.

J. K. Butler

J. K. Butler, President

WHELAND PLANETARY
HP-16000 PUMP
Duplex Power Slush Pump
7¾" x 16", 600 H.P. at 65 RPM



Wheland HP-16000 Planetary Pump owned by Oil Production Maintenance, Inc., on location in the Gulf Coast area.

WHELAND

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DOMESTIC DISTRIBUTORS: INDUSTRIAL SUPPLY COMPANY, INC.—Main Office: Wichita Falls, Texas • HOUSTON OIL FIELD MATERIAL COMPANY, INC.—Main Office: Houston, Texas.

EXPORT DISTRIBUTORS: LUCEY EXPORT CORPORATION—233 Broadway, New York 7, New York—Broad Street House, London, E. C. 2, England.

unusual or damaged pipe conditions. The camera and lighting are remotely controlled. Source: **Inspectoline, Inc.,** 9501 Euclid Ave., Cleveland 6, Ohio, U.S.A.

●

Scissors lift available in 2 models to lift one ton

Material-handling jobs can be made easier with a new 1-ton scissors lift now being sold in two models. One model is a stationary type; the other is movable on roller-bearing-equipped wheels. It is equipped with a jackhandle.

Both models come with a 10-ft. plug-in cord for operation on a 110-volt power source. A ½-hp. hydraulic pump operates the lift through foot controls. Two platform sizes are available: 18 by 42 and 24 by 48 in. Travel is 36 in. and lowered height is 6 in. Source: **American Mfg. Co., Inc.,** 2119 Pacific Ave., Tacoma 2, Wash., U.S.A.

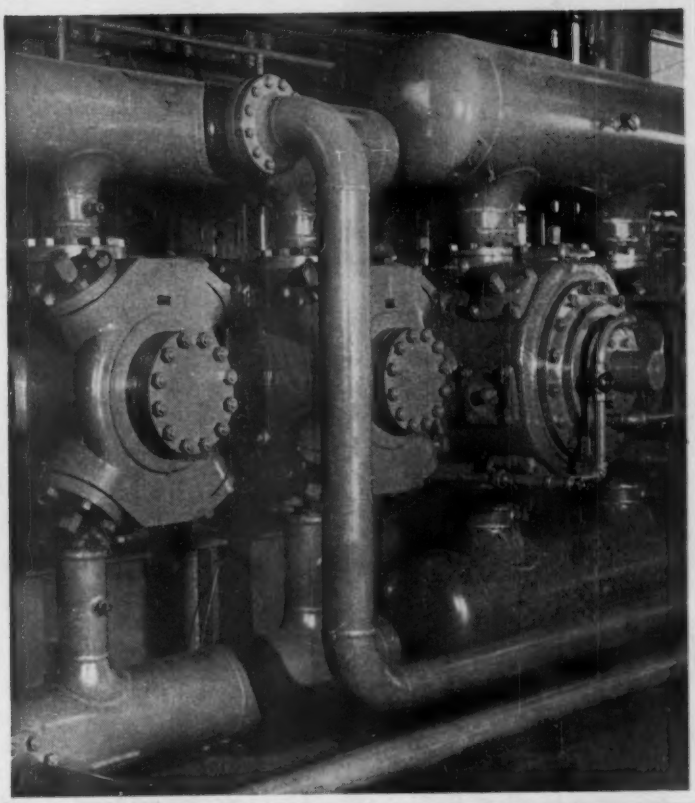
●

Miniature closed-circuit television for plant use

Existing television receivers can be used as monitors with the Tel-Eye TV camera recently developed for industrial use. As described by the manufacturer, the unit has an almost completely transistorized circuitry and provides high-definition pictures with good contrast characteristics. The complete camera is self-contained with a power cord for attachment to an a.c. source and a coaxial connector for attachment to a TV receiver.

The TV camera is expected to prove valuable for plant security systems and for process control. It can also be used as a visual teaching aid for plant personnel training. Source: **Allen B. Du Mont Laboratories,** 750 Bloomfield Ave., Clifton, N. J., U.S.A.

PACKAGED
COMPRESSOR PIPING...



another example of

BONNEY SWEEPOLETS®

for sophisticated piping systems

Designed to eliminate all notch effects, the Bonney Sweepolet provides optimum stress distribution for critical piping systems such as the compressor bottles shown above on Worthington SLHC-10 gas engine angle compressors rated at 950 BHP each. These units were fabricated by Worthington-Lockett using Bonney Sweepolets for branch construction. Specify and use Bonney Sweepolets in your critical piping systems.

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also exclusive manufacturers of
WELDOLETS®
THREDOLETS®
SOCKOLETS®
ELBOLETS®
BRAZOLETS®
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for all services

BONNEY FORGE AND TOOL WORKS
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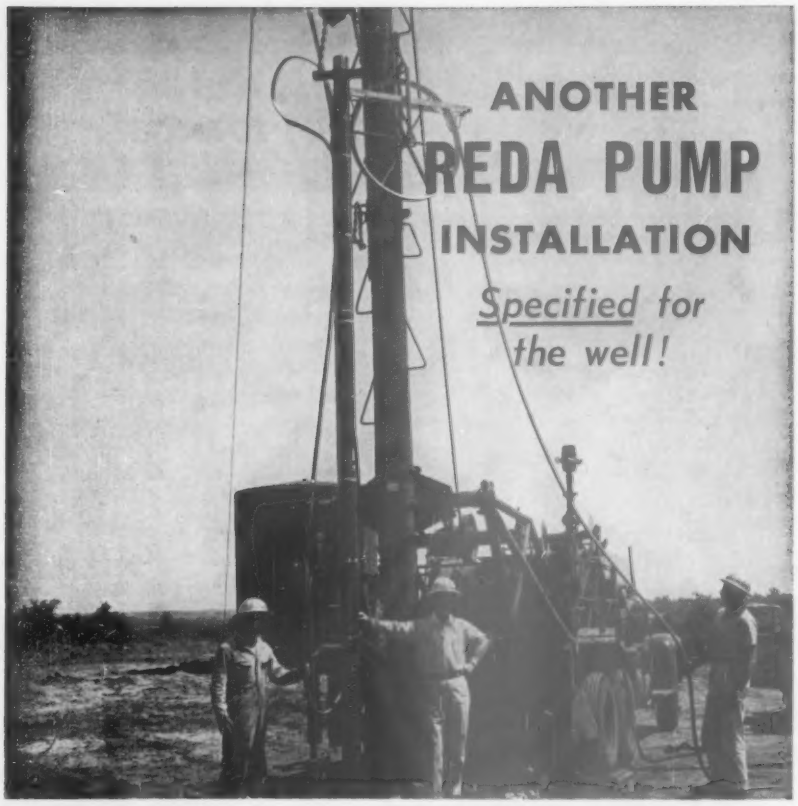
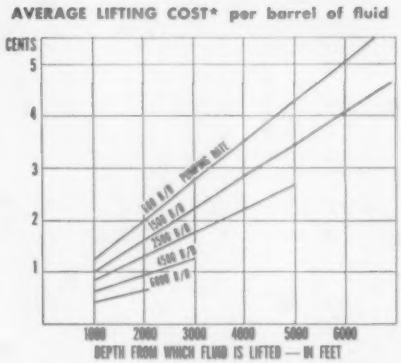


REDA Does the Job Better and at LOWER COST

Billions of barrels of fluid (oil and water) have been produced at an average lifting cost of less than one cent per barrel for each 1,000 foot lift. Chart "A" illustrates average lifting cost from 600 B/D to 6,000 B/D using Reda Submergible Pumps.

Most complete submergible pump line for producing oil wells, water supply wells, brine wells, etc. Sizes range from 5 to over 240 h.p. . . . models for wells cased with 4", 5½", 6⅜", 7" or 9⅝" casing . . . for depths from 500 to 10,000 feet, and for capacities of 100 bbl. to over 18,000 bbl. per day.



*Included: Electric Energy (10 Mills Per KWH), Run and Pull, Repairs, Upkeep, Transportation, Labor and Amortization (5 Yrs.)

Chart "A"

Write for Descriptive Folder R-686 Today

REDA PUMP COMPANY / BARTLESVILLE, OKLAHOMA

Manufacturers of Submergible Electric Motors & Pumps for over 40 years
Pumps for Oil, Brine, Water, Gasoline, Jet Fuel, Chemicals, LPG

SIGN OF QUALITY SUBMERGIBLE REDA PUMPS

What's NEW

. . . in literature

Hydraulic pumping equipment

Obtainable now, an eight - page catalog contains data on the design, operation, and field performance of new EOT - Johnston rod - counterbalanced hydraulic pumping equipment. Detailed engineering drawings show the operating principle of the control and slave cylinder. Included are performance data and specifications for the pumping units, along with field reports from operators. Source: **Engineered Oil Tools, Inc.,** 1710 Burnett St., Houston, Tex., U.S.A.

Motor-application guide

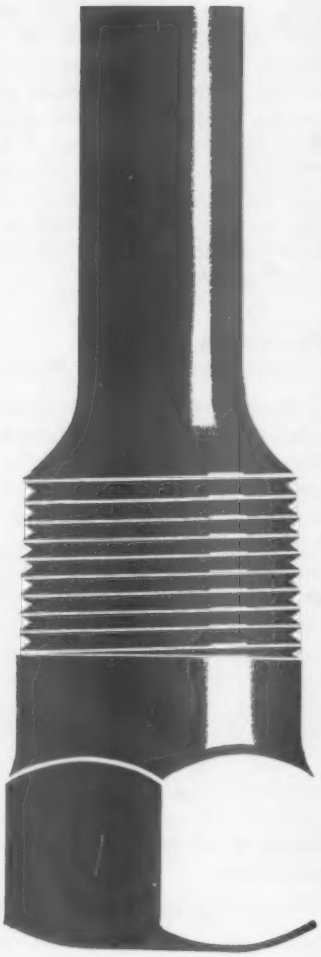
This 16-page publication describes single - phase, three - phase, and direct-current motors, while detailing gearmotors and selective-speed drives. Bulletin 010 contains two motor-selection charts: matching motor characteristics to specific applications for single phase and polyphase and d.c. motors. The publication discusses polyphase and single - phase - motor characteristics and includes rating and dimension tables. Source: **Century Electric Co.,** 18th and Pine Sts., St. Louis 3, Mo., U.S.A.

Area floodlighting made easy

Available without charge, this 16-page brochure gives quick reference guides for selecting incandescent or mercury floodlights, general purpose or heavy-duty types, and can be used for determining how many floodlights are needed, depending on the size of the area to be lighted. Bulletin 2719 offers foot - candle charts and installation diagrams, along with listings of floodlights and mounting accessories. Source: **Crouse-Hinds Co.,** 1347 Wolf St., Syracuse 1, N. Y., U.S.A.

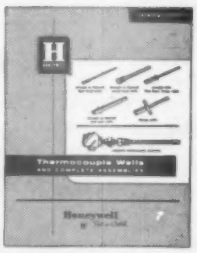
Stop leaks in gas wells

According to a new two-page literature piece, Dowell sodium silicate service has been highly successful in stopping leaks with tubing in place. The sodium silicate solution — sometimes called water



THERMOCOUPLE WELLS

Nine basic types of standard pressure-tight wells, with or without T/C assemblies, and any type of special wells made to order. All are beta-gage checked for concentricity. Thermocouple wells are among thousands of accessories—all available from a single dependable source—that can help your instruments perform at their very best.



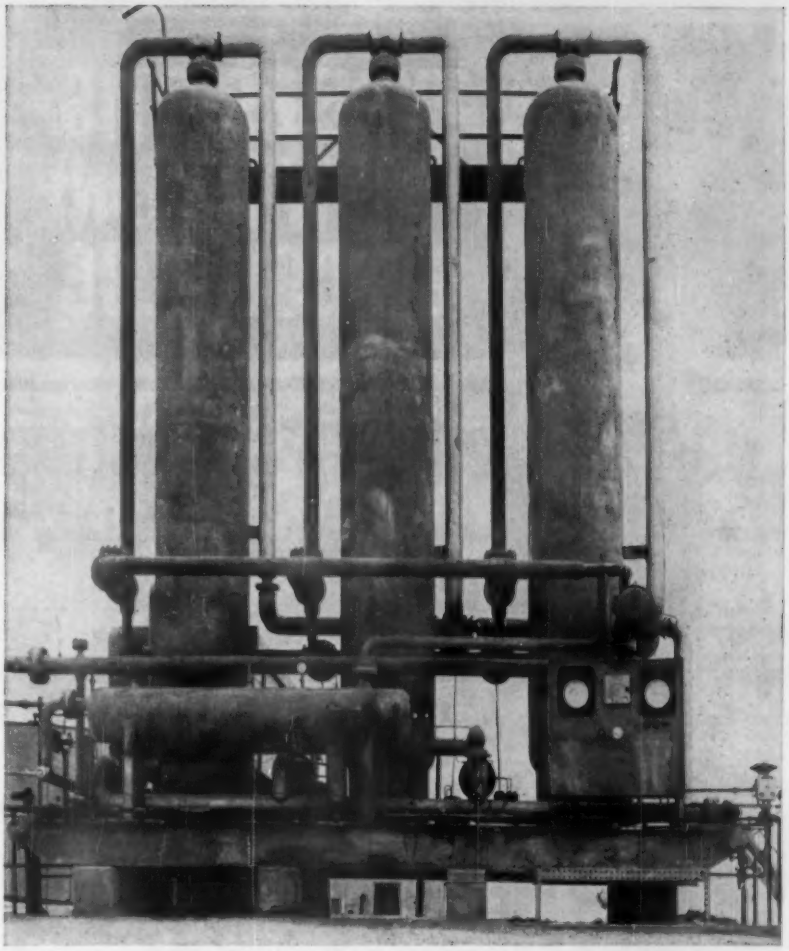
Get complete details from your nearby Honeywell field engineer, or write today for Catalog G100-5.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Honeywell

First in Control

SINCE 1885

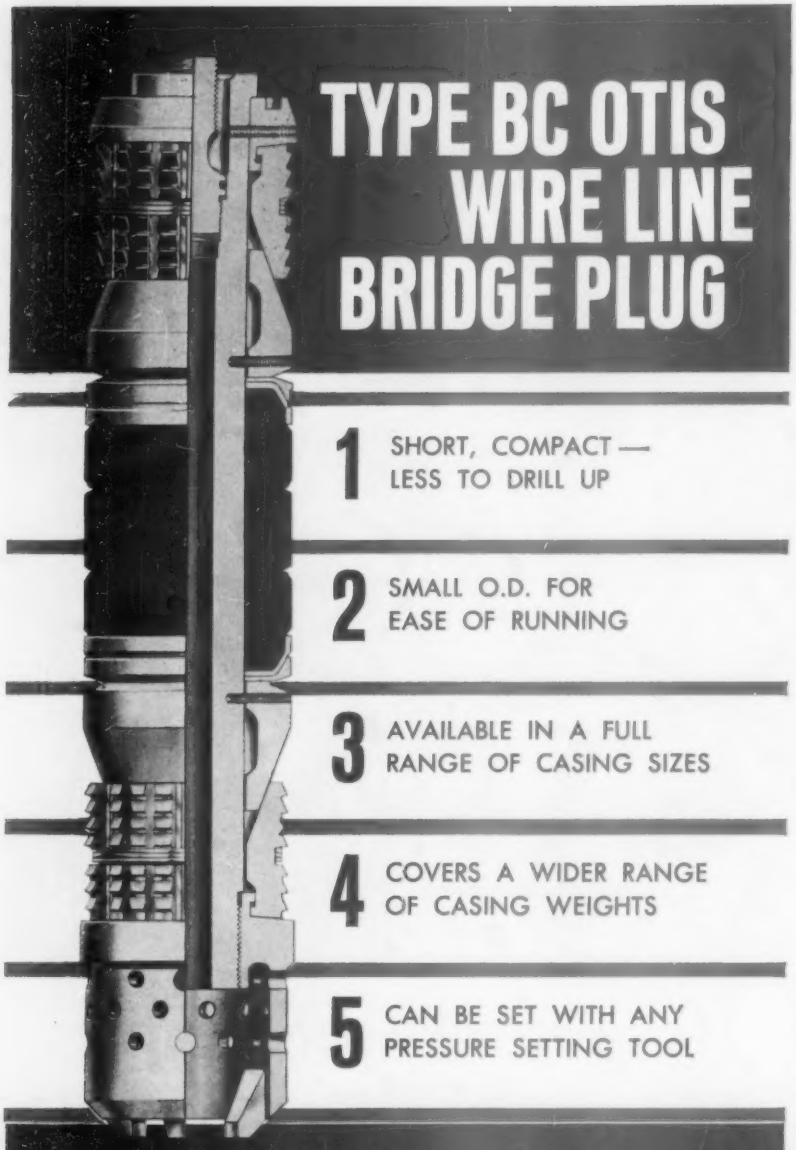


Hy-Sorb's Dependability Means More Earnings

This latest Maloney-Crawford Hy-Sorb three-tower recovery unit is designed for 23 MMSCF/D and 150 B/d of 14# stabilized R.V.P. product. This productivity can be accomplished with 18-minute cycles and M-C's special pre-cooling feature. One of the reasons for the high output is the Hy-Sorb's over-all dependability. A major factor in this dependability is the simplified control system which operates the entire plant from the panel shown at right in the photo. The Hy-Sorb can be operated automatically or manually, and a single selector switch controls all functions of the three towers. This unit is installed on Mustang Island, off the Texas coast, and is dimetcoated for weather protection. Another Texas operator reports that a Hy-Sorb, installed downstream from cold separation, has increased his stock tank liquids 22%. Let us give you more information on how the Hy-Sorb can increase your income from gas streams.

Maloney-Crawford

Box 659 **Tulsa**



TYPE BC OTIS WIRE LINE BRIDGE PLUG

1 SHORT, COMPACT — LESS TO DRILL UP

2 SMALL O.D. FOR EASE OF RUNNING

3 AVAILABLE IN A FULL RANGE OF CASING SIZES

4 COVERS A WIDER RANGE OF CASING WEIGHTS

5 CAN BE SET WITH ANY PRESSURE SETTING TOOL

Every time you specify the Type BC Otis Wire Line Bridge Plug, you get 5 plus features designed to help you take the guesswork out of your plugging operations—and yet the plug costs you no more than an ordinary plug. For this reason, many operators have standardized on the Type BC. They found they could successfully run the Type BC where other plugs failed to get down. In addition to the 5 big advantages you get with a Type BC Bridge Plug, you will find it's available from leading electric line service companies and stocked in over 200 different field locations — wherever you need it. Take the guesswork out of your plugging operations — the next time you need a bridge plug, specify Otis.

Type BC Otis Wire Line Bridge Plugs are available in these sizes:

SIZES	CASING WEIGHTS	SIZES	CASING WEIGHTS
2⅞"	6.4 — 8.6 lb.	5½"	13 — 20 Lb.
4½"	11.6 — 15.1 Lb.	6⅝"	17 — 24 Lb.
4½"	9.5 Lb.	7"	20 — 38 Lb.
5"	18.0 Lb.	9⅝"	43.5 — 53.5 Lb.

OTIS ENGINEERING CORPORATION

General Offices: 6612 Denton Drive · Dallas

Branches Throughout The Oil Country

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glass—is pumped into the tubing and allowed to fall by its own weight. This action covers the inside of the tubing with a hard glassy coating which is said to be capable of sealing pinholes and thread leaks. The literature offers advantages, case histories, and physical properties. Source: **Dowell Division of The Dow Chemical Co.,** Box 536, Tulsa, Okla., U.S.A.

Poxyglas corrosion-resistant tanks

Bulletin 45-115, just published, consists of applications, features of the glass-resin material, and a discussion of the manufacturing method of Poxyglas tanks. The tanks come in four sizes with capacities of 4,600, 8,500, 12,000, and 16,000 gal. The six-page bulletin includes a handy corrosion-resistance chart for use as a guide in the application of the tanks in corrosive service. Source: **Black, Sivalls & Bryson, Inc.,** 7500 E. Twelfth St., Kansas City 26, Mo., U.S.A.

Industrial television monitors

Four-page bulletin ECL 92 features both cabinet and rack-mount models in 14, 17, and 21-in.-screen sizes. The publication outlines the new Intra-Tel closed-circuit monitors' specific capabilities. Also supplied are control, accessory, size, and weight information and input, electrical, and environmental specifications. Source: **General Electric Communication Products Department,** Box 4197, Lynchburg, Va., U.S.A.

How to Buy a Ball Valve

This six-page literature piece (Bulletin HTB-261) enumerates eight important valve features that you should look for in a ball valve. It offers a cutaway drawing of a Series 701, top-entry, 150-lb., ASA flanged Flo-Ball valve and an exploded view showing the one moving part, seats and seals. A table lists the parts and their construction materials, while another includes prices and model numbers of each size from 1 to 8 in. Included are a dimension chart and a pressure-temperature-relationship curve.

Source: **Hydromatics, Inc.,** 5 Lawrence St., Bloomfield, N. J., U.S.A.

Free slide rule for sizing control valves

This slide rule solves for Cv and corrects for steam quality, gas specific gravity and temperature, and liquids specific gravity and viscosity. Conventional slide-rule scales A, B, C, and D are also incorporated. Provided are step-by-step instructions for using the slide rule. Source: **Fulton Sylphon Div., Robertshaw-Fulton Controls Co.,** Box 400, Knoxville 1, Tenn., U.S.A.

Four-page brochure covers turbolubricated swivels

Designed in five separate models, the swivels cover a drilling range from 4,000 to 30,000 ft. A cutaway drawing on the inside page shows construction details. The literature lists features which include high-pressure, easy-change packing, low center of gravity, high-capacity bearings, turbolubricated and streamlined steel body. Source: **Gardner-Denver Co.,** S. Front St., Quincy, Ill., U.S.A.

New guide to industrial weed and brush control

This 16-page brochure should prove useful in analyzing vegetation problems and selecting the right chemical or combination of chemicals to obtain desired results. Selection of the proper chemical or chemicals for a specific control problem may depend upon differences in plant species, rainfall, soil types, and various economic factors. Proper use of this guide can provide the key to long-term, least-cost weed and brush control. Source: **E. I. du Pont de Nemours & Co., Inc.,** 1007 Market St., Wilmington 98, Del., U.S.A.

New equipment catalog

Catalog 615, now available free, covers hydraulic-powered drill rigs, tools, and accessories. With illustrations and detailed descriptions, it includes specifications on over 1,900 items related to rotary drilling and soils exploration. The catalog features a water-air selector table which permits drill operators to determine at a glance the correct g.p.m. of drilling fluid or c.f.m. of air required for rotary sampling and coring. Another feature is a revised preface to the sample-tool section explaining techniques of modern subsurface exploration. Source: **Mobile Drilling, Inc.,** 960 N. Pennsylvania St., Indianapolis 4, Ind., U.S.A.

Professional advancement

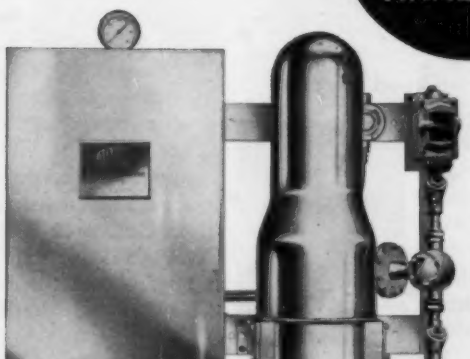
A new 12-page publication entitled "Supervision for Professional Advancement" is one more in a series that takes the engineer another step in training himself and others in human relations. The importance of maintaining good supervisory practices is illustrated in the fact that supervisory personnel are the key to uninterrupted production, completion of projects successfully and on time. Booklet E-7 requires less than 10 minutes reading time. Source: **Heat Exchanger Div., Western Supply Co.,** Box 1888, Tulsa, Okla., U.S.A.

OPTIMUM RETURNS THROUGH QUALITY CONTROL

• **A proved cost-cutter,** now operating in over fifty refineries, gasoline, and chemical plants. • **Increases yield and improves quality** by accurately and **continuously** monitoring ASTM end-point. Delays between quality change and compensating control are eliminated. Allows closer operation to end-point specifications. • **Reproducibility** far exceeds laboratory method. • Write for Technical Bulletin 5900-11.

Maximize your profits with the

TOTCO END-POINT ANALYZER



Totco also makes an Initial Boiling Point Analyzer. Write for Technical Bulletin 1259-11.

TECHNICAL OIL TOOL CORPORATION

1057 North La Brea Avenue, Los Angeles 38, California • OLdfield 4-1763

Gulf Coast Representatives: The Mott Co., 1719 McKinney, Houston 1, Texas

East Coast Representatives: Energy Control Corporation
3147 N. Broad Street, Philadelphia 32, Pennsylvania
Energy Control Company, Inc.
5 Beekman Street, New York 38, New York

TOTCO

▶▶▶ Equipment Men Notes

Frank Wheatley Corp. adds four

. . . to its engineering and sales staff. R. P. Hummel, formerly assistant chief engineer in charge of the construction engineering department at Dowell, has been named chief engineer. Vernon Walker will serve as sales representative in the Rocky Mountain-Kansas area, handling the complete line of valves distributed or manufactured by the Tulsa firm.

J. O. (Jimmy) Lindsey has been appointed special sales representative, working exclusively with supply stores in Oklahoma. He is former senior buyer for Shell Oil Co. in the Tulsa area. John Anderson, with Douglas Aircraft Co. and American Airlines the past 18 years, will assume the duties of representative at large. Anderson will travel in the Rocky Mountain, Southwestern, Canadian, and Mexico sales territories.

Grant Oil Tool Co. promotes

. . . Anthony A. Sylvester to secretary-treasurer. Sylvester joined Grant in 1953 as chief accountant and office manager. He is chairman of the Oil Field Division and a member of the board of directors of the Credit Managers Association of Southern California.

Bentsen elected Reed director

. . . according to John Maher, president and chief executive officer of Reed Roller Bit Co. Lloyd M. Bentsen, Jr. is president of Lincoln Liberty Life Insurance Co., and is on the board of directors of the Bank of the Southwest and the Southwestern Savings Association. From 1948 to 1955 he served in the U. S. Congress from the 15th Congressional District of Texas.

L. M. Bentsen, Jr.

Dr. Jerald M. Honeycutt joins

. . . Jefferson Chemical Co., Inc. as a staff engineer, it was announced by L. F. Dowdning, general manager of corporate services. Dr. Honeycutt will be responsible for process analysis and optimization and for application of systems engineering and operations research methods to company operations. In addition, he will investigate electronic computer applications, including automatic process control. His location will be in Houston.

Guiberson Corp. promotes two

. . . to new positions, according to Robert L. Boyd, executive vice president and general manager. Earl W. Davis takes over as field sales manager, and H. H. McKinney assumes the title of manufacturing manager.

E. W. Davis

H. H. McKinney

Davis, formerly assistant sales manager, began his employment with Guiberson 20 years ago. He joined the sales department in 1957. Davis will work out of the Guiberson main office in Dallas.

Formerly shop superintendent, McKinney now assumes full responsibility for all manufacturing operations at Guiberson. Prior to joining the corporation in 1946, he served as assistant chief engineer of Guiberson Diesel Engine Co., an affiliated company, and as chief engineer of the Texas Division of Continental Motors Corp.

Bucyrus-Erie Co. appoints

. . . Selden A. Stone as assistant drill sales manager of blast-hole drills, water-well drills, and oil-well spudders. An 18-year veteran of the firm's Drill Sales Division, Stone had been well drill sales manager of oil and water-well drills for the last 5 years.

Atlas Bradford Co. is new name

. . . for all divisions of the company upon their integration into one organization. This marks the final phase of organization changes resulting from last year's merger of Bradford Supply Co., Bradford, Pa., with Atlas Pipe, Inc., Houston, and its divisions to form Atlas Bradford Co. Hardy-Griffin Engineering Corp. and Universal Inspection & Service Co. were Atlas divisions at that time.

Jones & Laughlin Supply names

. . . two new district store managers, announces A. G. Bastian, manager of field operations. G. R. Edwards has been promoted to district store manager at Shreveport, and G. L. Berry takes on the same responsibility at St. Elmo, Ill.

Edwards was first associated with J&L as a storeman at Duncan, Okla. in 1947. He was promoted to store manager at Beaumont in 1950, and was transferred back to Duncan as store manager the following year. Berry started with the division as a storeman at Gladewater, Tex. in 1951. He was promoted to store manager at St. Elmo in 1954.

William Rollins, Jr. is manager

. . . of Pipe Inspectors Division of Plastic Applicators, Inc., Houston, moving from his previous post of manager of Pipe Inspectors' South Louisiana district. Rollins was formerly a partner in Pipe Inspectors. He joined Plastic Applicators when Pipe Inspectors was acquired in 1959. Before that he had 9 years of oil-field engineering and sales experience.

W. J. Salemme is chief engineer

. . . for all engineering operations of Shand & Jurs Co., a subsidiary of General Precision Equipment Corp. Salemme takes to his new post 17 years of electro-mechanical-engineering experience with Western Electric Co., Vitro Corp. of America, Precision Technology, Inc., and Applied Radiation Corp.

Daniel Orifice Fitting Co. names

E. E. Lowe

. . . E. E. Lowe as manager of its manufacturing department in Houston, in which post he will coordinate and supervise production at Daniel plants in Houston and Los Angeles. Lowe joined Daniel in 1957 and became Los Angeles plant superintendent in 1959. Bob Reynolds, former welding foreman at the West Coast plant, will succeed Lowe as plant superintendent.

Argentina dealer is appointed

Adolfo Iglesias

. . . by Cabot Corp., Machinery Division of Pampa, Tex. Adolfo Iglesias, of Buenos Aires, is the new exclusive dealer in Argentina for Franks and Cabot oil-production equipment. Iglesias' organization acts as advisors to private enterprise in the exploitation of hydrocarbons and auxiliary servicing jobs, while assisting clients in selecting equipment.

W. D. Dauphin is appointed

. . . personnel director of Independent Exploration Co., Houston. A 25-year-company veteran, Dauphin started with the firm as a seismic-crew helper in 1936. His most recent assignment was as assistant manager of Independent's Weight Dropping Division at San Angelo, Tex.

Oil Center Tool is constructing

. . . a new manufacturing plant at Cordoba, Argentina to produce oilfield equipment and products of other subsidiaries of Food Machinery & Chemical Corp. FMC Argentina S. A., a newly formed FMC subsidiary, will operate the plant.

Construction began June 1, with completion expected within 4 months. Initial production of O-C-T equipment and other FMC products will probably begin late this year. The plant will be located on a 100-acre site on the outskirts of Cor-

● *Johnston Vertical Pump Case Study:*

Mobil Oil Refinery, Torrance, California

The Mobil Oil Refinery in Torrance, California, has a capacity of approximately 100,000 barrels per day. Practically all processes in the refinery produce light hydrocarbons which are gathered and fractionated into several relatively pure components. These components, which include normal butane, are pumped to spherical pressure vessels for intermediate storage.

From the pressure vessels the butane is pumped to the tank farm to be blended into gasoline or to LPG trucks for delivery to customers.

Johnston Pump 5-year Record

Of all the Johnston pumps in light hydrocarbon service in this Mobil Oil Refinery, the Johnston that pumps liquified butane from the pressure vessels to the tank farm, one-half mile away, is probably most used. This pump has not been pulled for maintenance for more than 5 years.

Johnston 50 HP Pump Between Pressure Vessel and Tank Farm

More Johnston Verticals

Johnston has a reputation in the industry as a specialist in vertical pumps. The 50 HP mentioned above is called in the industry a Butane Blending Pump. It is basically a transfer pump.

Specifications are given in Fig. 1 together with other Johnstons, one or more of which are at work for Mobil Oil in Torrance. The schematic (Fig. 2) shows the method of transferring the butane, but it doesn't include the two 5 HP units listed in the specifications. These two Johnstons are a part of the TCC process installation. They are in continuous operation, pumping water containing a high percentage of H_2S away from the gasoline accumulator.

#1—Barrel Pump • 700 gpm capacity • 284 ft. head • 50 hp. • 6 stage, 12 BC bowl assembly
#2—Barrel Pump • 100 gpm capacity • 1200 ft. total dynamic head • 30 hp. • 20 stage, 6 AC bowl assembly
#3-4—150 gpm capacity • 290 ft. head • 7½ hp. • 14 stage, 7 CC bowl assembly
#5-6—62 gpm capacity • 144 ft. total dynamic head • 5 hp. • 3 stage, 6 AC bowl assembly

FIG. 1

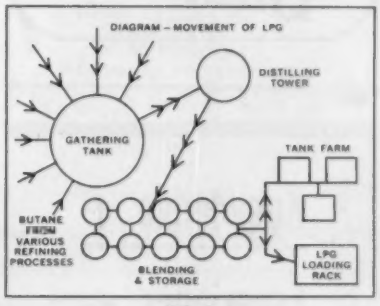


FIG. 2

Johnston pumps have been dependable servants of the oil industry for many years in refineries, pipe lines, water supply and injection service for secondary recovery and offshore work.

A trained Johnston field man will be glad to give you complete information or show you how Johnstons can best serve in your operation. There is a Johnston field man located in your area. A call to the Factory or branch nearest you will put him in touch with you within a few days.

JOHNSTON PUMP COMPANY

Main Factory: Pasadena, Calif., 3272 E. Foothill Blvd.; Phone: MU 1-7601
Factory Branches: New York 20, N.Y., 30 Rockefeller Plaza; Phone: PL 7-0431 • **Atlanta 1, Georgia,** 57 Forsyth St., N.W.; Phone: JA 3-7395 • **San Francisco 8, Calif.,** 260 Kearny St.; Phone: EX 2-0338 • **Roswell, N.M.,** 2007 S.E. Main; Phone: MA 2-5942 • **Pecos, Texas,** Balmorhea Highway; Phone: HI 5-3022 • **Idaho Falls, Idaho,** South Yellowstone Hwy.; Phone: JA 2-8144

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BrakeSol INC.
PARAFFIN TREATING CHEMICAL
For Paraffin Control
HOLDS PARAFFIN IN SUSPENSION
AT SUPPLY STORES
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Knowledge +
Experience +
Planning
= Sound Financing

Riverside 1-4181
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MERCANTILE
National Bank
at Dallas

doba, about 400 miles northwest of Buenos Aires. Argentine nationals will staff the plant almost entirely. Five FMC-O-C-T personnel will go to Argentina to manage operations.

Technical Oil Tool Corp. names

... Energy Control Corp., of Philadelphia, and Energy Control Co., Inc., of New York City, as East Coast representatives for the distribution of Totco end-point analyzers and initial boiling-point analyzers. Personnel of the two companies are currently being trained at the Totco factory on the application and installation of these control instruments.

Milwhite Mud Sales Co. shifts

... Leonard T. (Mink) Matuszewski to Houston as city salesman. Matuszewski joined Milwhite in Calgary in 1959 as a salesman. Prior to joining the company he worked for Bethlehem Supply Co. in Abilene and Calgary.

William C. O'Neill becomes

... field representative for Dresser Mfg. Division, Dresser Industries, Inc., according to James M. Hughes, sales manager. O'Neill will be responsible for the marketing of the division's pipe joining and repair products to equipment-manufacturing industries on the Gulf Coast and throughout Southern Texas. He will operate from the firm's Houston office. O'Neill is a veteran of sales and engineering positions with Thornhill-Craver, Gulf Supply Co., and W-K-M.

Ingersoll-Rand Co. completes

... the acquisition of Aldrich Pump Co., which now becomes a wholly owned subsidiary, according to Robert H. Johnson, chairman and chief executive officer of Ingersoll-Rand. Johnson was elected president of the new subsidiary. The other officers are: Carl H. Vaupel, vice president and general manager; E. J. Parish, vice president; and R. J. Kuntz, secretary and treasurer.

Guy J. Coffey elected chairman

... of the board and chief executive officer of Chicago Pneumatic Tool Co., succeeding H. Arnold Jackson.

G. J. Coffey

Norman Readman

Jackson will continue as a director and chairman of the executive committee. Norman Readman has been elected president succeeding Coffey. Readman was formerly managing director of all overseas operations of the company.

Thomas F. Noonan was elected vice president and comptroller. His association with the company began in 1938 and he has been comptroller the past 2 years. Carra L. Lane was elected vice president and manager of plant operations. He joined Chicago Pneumatic in 1959. Prior to that he was president and general manager of Security Engineering Division of Dresser Industries, Inc.

Lewis J. Burger new president

L. J. Burger

... of LeTourneau - Westinghouse Co., succeeding Merle R. Yontz who resigned to take a position with Caterpillar Tractor Co. Formerly associated with General Electric in various management capacities, Burger went to Peoria from Fort Wayne, Ind.

Burger served consecutively at GE as general manger of the gear motor and transmission-components department, gas-turbine department, Switchgear & Control Division, and laboratory operations of the Components Products Division.

Name change is announced

... by Food Machinery & Chemical Corp. The firm will change its name to FMC Corp. starting July 1. Chairman Paul L. Davies said that the company had outgrown its name

based on the fact that sales of machinery and equipment to the food industry represent less than 25% of the company's total business volume.

A. Foster Sheller appointed v.p.

A. F. Sheller

. . . in charge of manufacturing for Waukesha Motor Co. Sheller joined Le Roi Co. in 1930 at West Allis, Wis., where he was elected a director and made vice president in charge of manufacturing. He left Le Roi to become vice president of manufacturing for Phoenix Hosiery Co. in Milwaukee, where he remained until 1956. In 1957, after acting as a management consultant, he joined Waukesha. Sheller was named manufacturing manager in December 1959.

The company also announced the retirement of J. G. Swain, company vice president. Swain served as a company officer since 1949 and as a member of the board of directors the past 28 years.

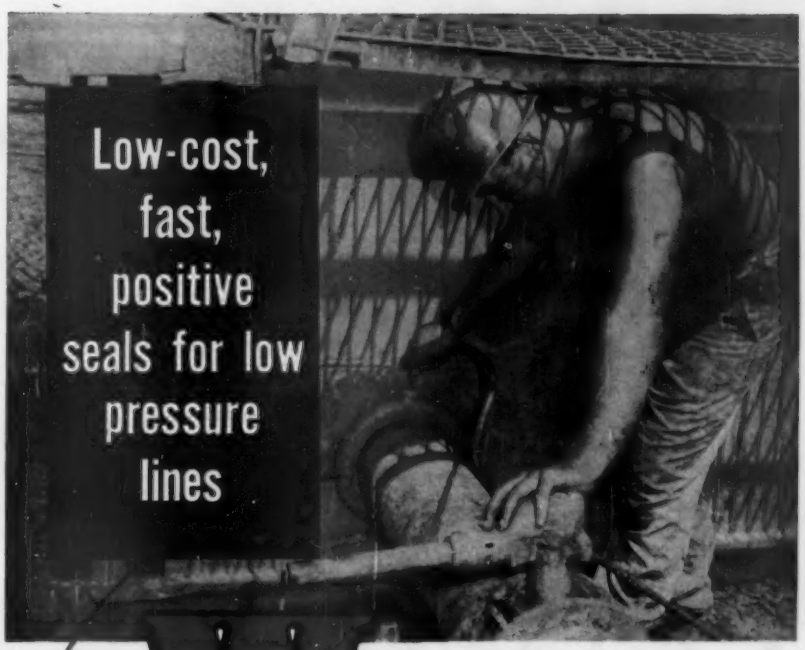
Carl J. Oldenburg becomes

C. J. Oldenburg

. . . eastern sales manager, petroleum chemicals, for Oronite Division of California Chemical Co., a subsidiary of Standard Oil Co. of California. The announcement was made by T. M. Welton, vice president of marketing. Oldenburg, a 17-year company veteran, will be headquartered in New York City. Previously he was Oronite's midwestern district sales manager for 3 years, headquartered in Chicago.

W. A. Baden elevated to president

. . . of Western Supply Co. He will assume his new duties July 1. Baden was president of Anchor Petroleum Co. prior to its sale to Mobil Oil Co. last January. He has been acting in a consulting capacity to Mobil since that time.



WECO®

AIR-O-UNION

Seals with a shot of air

With low-cost WECO Air-O-Unions welded in place on tanks . . . lines and fittings are made-up with less time and trouble. A shot of air expands and seals the inflatable tube around the pipe. To disconnect you simply deflate the tube.

The seal of the Air-O-Union is not affected by slight misalignment, vibration, expansion or contraction of the lines. Switch to simple, time-saving, low-cost WECO Air-O-Unions for all low pressure lines on your rig.

Air-O-Unions available in sizes 4" through 16" are stocked by Supply Stores everywhere.

WECO® WELL EQUIPMENT MFG. CORP.
HOUSTON, TEXAS
Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION

AO-1-61

fmc®

If you're caught in the cost squeeze

Get the facts about WINCHMOBILE JR.

Wilson

Before you buy get the facts on light weight... low cost... long life Winchmobile Junior with the cross mounted engine which saves moving parts and increases hp to the drum by 15%!

WILSON MFG. CO., INC.
Wichita Falls, Texas • The Home of RED IRON

Winchmobiles Traveling Blocks Speedwinches

Slush Pumps 3000' to 25000' capacity Rigs

Two-unit compressor is readily air-lifted by helicopter

Special-design air drill uses 'copter lift in rough country

BIG-RIG TECHNIQUES are modified for this shallow-hole exploration drilling. For air drilling of shot holes in remote and rugged Utah area, Pan American Petroleum Corp. found it necessary to transport its men and machinery in this cliff-bound sector of the Rocky Mountains.

In a locale where no water was found in the near-surface beds, air drilling was deemed the best approach. Problem was to bring in an air compressor that could be readily transported. Airlift from location to location was accomplished by a Bell Helicopter provided by Petroleum Helicopters, Inc., of New Orleans.

Standard compressors were deemed too bulky and unwieldy for this operation so a special unit was designed by Power Rental Equipment Co., Denver. The Worthington Corp. compressor was divided into two units, each weighing less than 500 lb. each.

In top photo, the craft has just deposited the units which are

MARTIN RUBBER & DUCK RINGS give excellent life in dirty abrasive fluids . . . high or low gravity . . . much or little water . . . shallow or deep wells. They last for years in the easier pumping wells. Replacement rings cost comparatively little.

MARTIN PLUNGER BODIES, precision grooved, drilled and threaded (no underneath fluid passage), usually last for years. Tube or barrel costs are often cut in half.

The replaceable SYNTHETIC RUBBER GUIDES in MARTIN CAGES last longer than any metal, and the cushioning of the ball increases your ball & seat life. Results are often truly amazing. (Patent No. 2,591,174)

Write for our new catalog or see it in the Composite (24th Edition). All products sold thru supply companies.

JOHN N. MARTIN
Manufacturer
9 W. BRADY STREET • TULSA, OKLAHOMA

carried singly under the copter's belly. The lower picture shows the drill in action in the background. In the foreground a drilling supervisor checks the compressor, a Worthington modified rotary 85 c.f.m.

Two Florida wildcats abandoned as dry

ACTIVITY in southern Florida has resulted in two recent dry completions while a new location has been staked. The ventures which have been abandoned are the Humble Oil & Refining Co. B-2 Gulf Coast Realty and the California Co. and Coastal Petroleum Co. 1 State Lease 224-B.

Humble drilled its well, C SE 13-48s-28e, Collier County, to 12,076 ft. A drill-stem test 11,855-12,075 ft. recovered 30 ft. mud with no shows. The California Co. & Coastal test is in 44s-20e, Lee County, with total depth at 14,000 ft., drilled and abandoned.

A new location was made by Gulf Oil Corp. and California Co. offshore in Monroe County. The well is 1 Marquesas OCS, located in Block 46, Lat. 24° 26′ 8½″ N., Long. 82° 29′ 25″ W. The new effort is scheduled for 16,000 ft. Offshore Drilling Co. is the contractor.

New directory of IOCC is out

THE 1961 DIRECTORY of the Interstate Oil Compact Commission with headquarters in Oklahoma City has been released.

The commission is comprised of the governors, and their representatives, of the following states: Alabama, Alaska, Arizona, Arkansas, Colorado, Florida, Georgia, Idaho, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Montana, Nebraska, Nevada, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Washington, West Virginia, and Wyoming.

The new 18-page directory is published and distributed by Interstate Oil Compact Commission, Box 3127, Oklahoma City 5.

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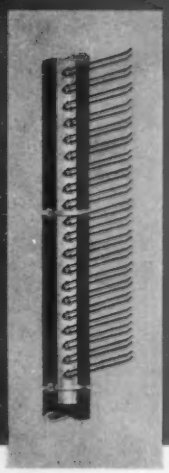

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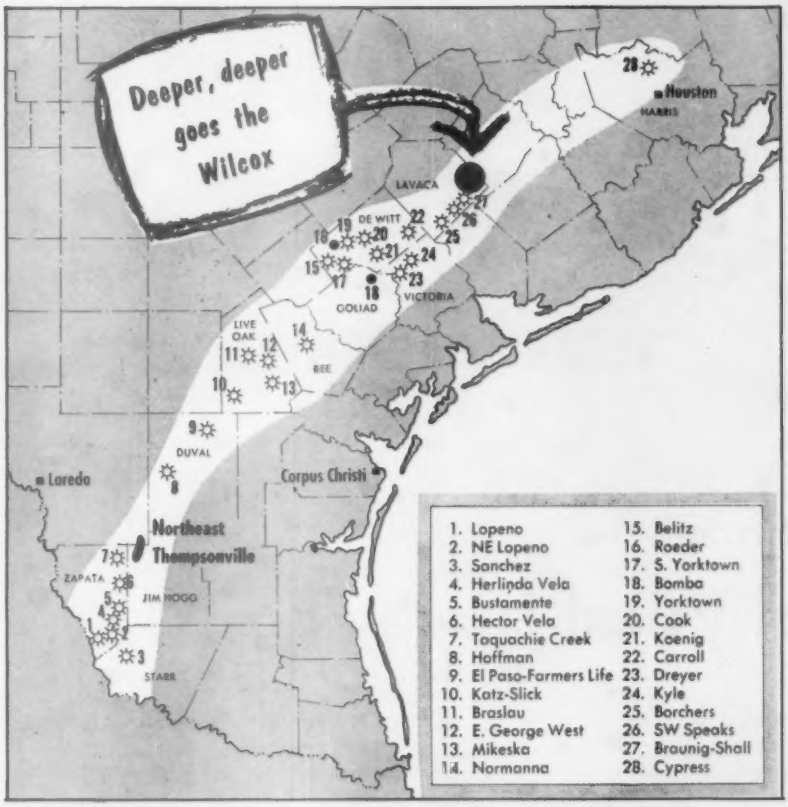


THIS DEEP WILCOX TREND gained its deepest field, and the Texas Gulf Coast a new producing-depth record, when Pure Oil Co. finished its 1 Kolar in Lavaca County at 16,357-16,404 ft. Fields shown here all produced from depths of 8,500 ft. or more. Best find so far is Northeast Thompsonville field near the southern terminus of the trend.

Gulf Coast has a new champion at Vienna

BY FRANK J. GARDNER

SOUTH TEXAS' deep Wilcox trend set a new record last week. This busy belt of ultradeep fields added its thirtieth reservoir, and at the same time, set a new producing-depth record for the Texas Gulf Coast.

In Lavaca County's Vienna field, a shallow (8,400 ft.) Wilcox producer, Pure Oil Co. completed its 1 Kolar in the deep Wilcox through perforations at 16,357-16,404 ft. Open-flow potential at the well was 4,700 M.c.f. gas per day, and shut-in pressure on tubing showed 10,600 psi. Location of the well is in the M. Muldoon Survey A-34, 9 miles south of Sheridan. Pure carried the hole to total depth of 16,730 ft.

A record breaker . . . By completing the well at this depth, Pure exceeded the previous depth record for Wilcox production by more than 3,000 ft. That record was set early this year when Gulf Oil Corp. finished its 1 Hector Vela (No. 6 on map) in eastern Zapata County at 13,272-82 ft. Thus, Pure has expanded the vertical dimensions of this important gas source and will greatly influence deep-drilling programs of the future throughout the Middle Gulf Coast.

Vienna field was first found 20 years ago, when Oil Drilling, Inc., made a gas-condensate discovery at the 1 Allen & Miner. In 1945, oil was discovered, and until now, all production has come from the upper Wilcox section between 8,362 and 8,515 ft. There are now 11 oil wells and 7 gas wells in the field. Oil allowable is 600 bbl. daily.

Success at this deep venture should revitalize deep-drilling activity at Vienna and surrounding fields. It brings to mind the drilling of a deep test in Provident City field, 4 miles southeast of Vienna, several years ago. Shell Oil Co. sank the hole to 16,100 ft. and at that depth, encountered tremendous gas pressures in the Wilcox, but because of mechanical failure, it was plugged back to the shallower Wilcox field pay.

Presents a new challenge . . . The discovery at Vienna is the northeasternmost one in the main body of the deep Wilcox trend (see map). Not only is it of importance to the immediate Lavaca County scene, but to several upper coast counties as well, especially those between Lavaca and Harris, where Cypress field is the northeastern anchor of the trend at present. Much remains to be done in deep Wilcox exploration in Colorado, Austin, Waller, Wharton, and Fort Bend counties.

The Wilcox hunt has not thrived in these upper coast counties as it has in those to the south. This is in part due to four resounding failures in Fort Bend, Harris, and Jackson counties in 1954 and 1955; these found extremely thick shale sections in the Wilcox, with no sand reservoirs. One, in Jackson County's West Ranch field, went to 19,056 ft. and drilled no sand at all below 8,500 ft.

So once more, the Wilcox has sprung a surprise on Gulf Coast operators. This unusual formation, erratic and difficult to predict in subsurface section, has always been a challenge to geologists. Its shifting pattern of porosity and permeability, its thick shale sections, and its stratigraphic whimsey have produced success and failure in about equal quantity. The Vienna strike only emphasizes the challenge.

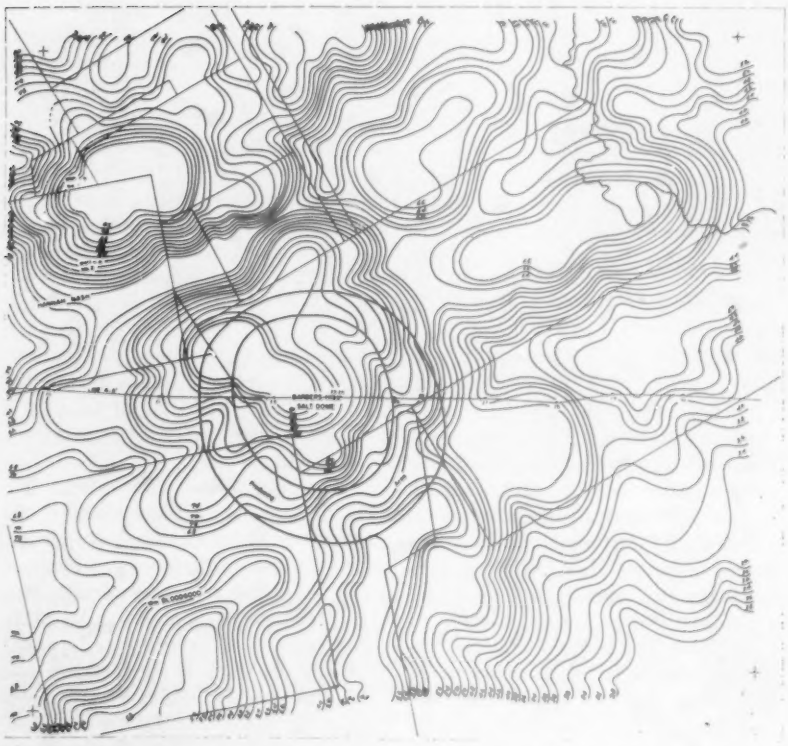
TYPE AIRCRAFT deemed suitable for airborne electrical field intensity surveying is this twin Beechcraft. Plane should be at least this size, or larger. Fig. 1.

You can skip over terrain hazards with

airborne geophysical surveying

BY L. Q. GAITHER AND W. G. EGERTON

L. Q. Gaither is with Gaither Explorations, Inc., Weatherford, Tex., and W. G. Egerton is a consulting engineer, San Antonio.



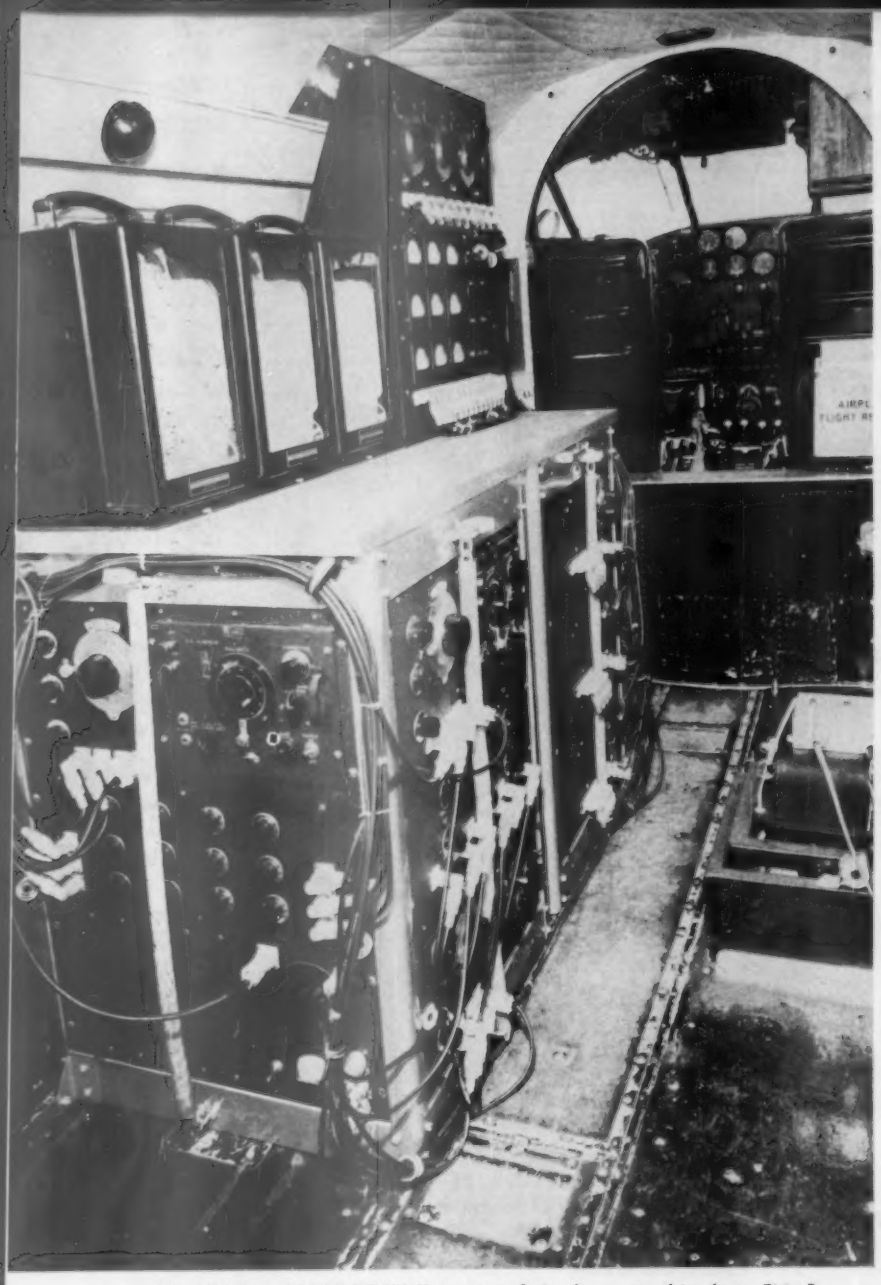
FIELD INTENSITY MAP of the Barbers Hill oil field, Chambers County, Texas, was flown in east-west traverses for detail. Fig. 3.

HERE IS a method of geophysical surveying where the area to be surveyed is flown in a series of traverses with a conventional two-engine airplane. Continuous recordings are made of one or more electrical fields produced from separate sources.

The recorded information is analyzed and contoured on area maps with the higher-intensity contours correlative to geological features. Horizontal control is accomplished by aerial mosiacs; aerial photos are shot during the survey and are synchronized with the recorders.

The approach. Surveying from the air is not new to the industry. A number of methods have been developed in the past; prominent among these are magnetic, gravity, and gamma-ray surveys.

This aerial method obtains its data from one or more electrical fields which are artificially generated from separate sources. The energy which produces the fields is in the medium-frequency spectrum in the 1-mg. range. Enough frequency separation is maintained to prevent interference with each other. The energy produced by each field is recorded on a separate continuous recorder, resulting in energy intensity versus horizontal distance along the traverse. Enough traverses to



INSTRUMENT ARRANGEMENT in aircraft is shown in this shot. Fig. 2.

detail the area are made, and the combined information is analyzed into contour form. Values are assigned to the contours which indicate the field intensity in terms of microvolts per meter. The higher-intensity contours correlate very well with geologic structure at highs.

The theory of ground conductivity has been established for a number of years. A ground-conductivity map[1] of the United States shows broad areas of conductivity in terms of milliohms per meter. While such a map is of little value for local geological information, it is a useful tool for predicting the field intensity of a radio station at a given distance for a specified amount of power.

The theory of ground conductivity does not fully explain why a higher-indicated-intensity field can occur over a high geological structure. Nor does it explain why the high intensity may be measured farther from the source of energy as compared with a lower intensity occurring closer to the source. The well-established and combined theories of transmission by means of a transmission line[2] and the so-called wave-tilt theory[3] give valid support to the fact that these higher-indicated intensities can occur.

There is no complete agreement on how deep electrical energy penetrates below the surface of the ground. Generally speaking, theory predicts that the higher the frequency of the electrical energy, the smaller the penetration below the surface. Some effort has been made to measure the depth of penetration by placing transmitting equipment in deep mines and measuring the field intensity at the surface of the ground. While this method supports the fact that electrical fields penetrate to appreciable depths below the surface, the work is not conclusive since it is impractical to eliminate the probable effects of passageways in the mine as a possible medium of electrical transmission.

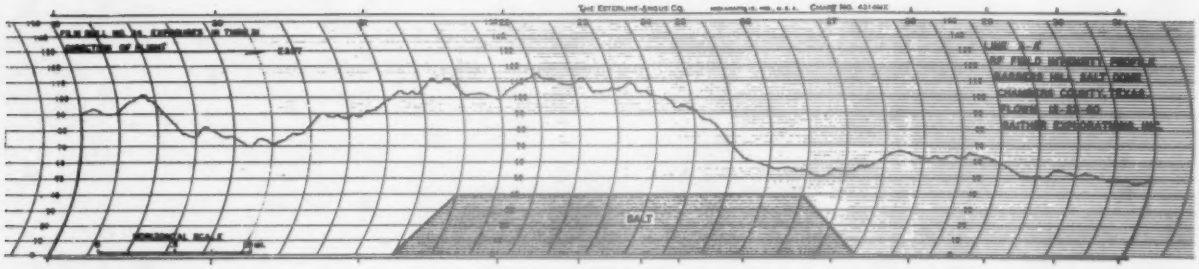
In several years of development work with this method of geophysical surveying, it was learned that deep-seated structures can be successfully located. Yet without any geological evidence of their presence near the surface, one or both of the following theories must be recognized.

First, that electrical fields penetrate to greater depths below the surface of the ground than current theory predicts, and second, that deep-seated structures produce conditions near the surface of the ground that effect electrical fields.

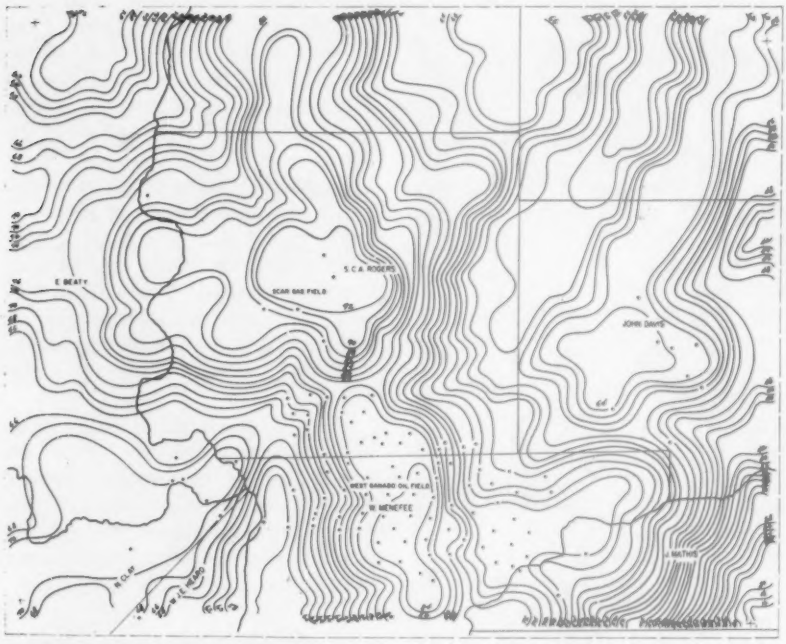
Equipment. The airplane used to fly the surveys (Fig. 1) has been found to be the minimum size suitable for this service. The instruments are mounted in the cabin portion of the ship leaving enough room for the geophysicist, pilot, and an observer, if desired.

The equipment used to measure the field intensities follows the normal, accepted approach of those used in the main standard factory units. Fig. 2 is a picture of the equipment mounted in the airplane. In the upper left-hand corner are three Esterline-Angus recorders which provide a continuous and permanent graphic record of the field intensities.

To the right of the recorders are mounted the input units associated with the three channels, together with metering and switching facilities. The cabinet under the recorders houses three detectors and amplifiers, three frequency standards, including attenuators, couplers, and power supplies. The camera in the



EAST-WEST LINE A-A' in Fig. 3, is seen in detail in this profile. This traverse shows the Barbers Hill anomaly between stations 21 and 26. Fig. 4.



THIS SURVEY was first flown in 1953 and reflown in 1961 to determine the degree of repeatibility. The above new map agreed closely with earlier data in the West Ganado area, Jackson County, Texas. Fig. 5.

lower right-hand portion of the picture is synchronized with the recorders and is used to make periodic pictures during the time of the traverse. These are later correlated with aerial photography for horizontal control.

Procedure. Aerial photography covering the area to be surveyed is prepared with enough traverse to overlap the area. These traverse lines are flown by point-to-point visual navigation. Periodic pictures with cross lines and synchronizing markers on the recorded chart are made during the time of the traverse for additional aid in horizontal control. The measured field intensity from one to three electrical fields is fed into the continuous recorders and results in a measure of field intensity versus horizontal distance. These data are then plotted on a suitable base map and contoured in the conventional manner.

Piercement Salt Dome

Typical results produced by this method of surveying along the Gulf Coast of Texas are mapped in Fig. 3. The example is Barbers Hill oil field in Chambers County. The area included within the survey is approximately 6 by 6 miles and 13 east-west traverses were flown for detail.

Typical recorded field-intensity traverses of the survey are seen in Fig. 4. This goes across the top of the structure shown as line A-A' in Fig. 3. Barbers Hill field produces from a piercement-type salt plug which comes to within a few hundred feet of the surface. It will be noted that the closed high-intensity field contours outline the structure quite well. The original survey of this area was made in 1953, and the current survey (illustrated in Figs. 3 and 4) was completed in December 1960. Despite 7 years separation in the two surveys they completely agree in all important details.

Occurring about 2½ miles northwest of Barbers Hill is another set of closed high-intensity field contours. High structure in this area is supported by two wells[4], Nos. 1 and 2, which were drilled subsequent to the original survey, about 4,000 ft. apart. Correlatiton on the base of the Frio shows the 1 well to be 450 ft. higher than the 2 well. Since the regional dip in this area to the south is about 150 ft. per mile, high structure is indicated. These phenomena—existence of closed high-intensity contours occurring close to known domal-type structures—have been observed on a number of occasions. Notable among them are Barbers Hill and West Ganado oil field, both of which are illustrated, and Francitas field in Jackson County, Texas. Because this survey method produces information which can be correlated with structure at highs closely associated with known domal-type structures, it provides an exploration approach in a region considered to have already been explored, or for a region which does not lend itself to interpretation by other geophysical methods.

An illustration of the results expected over deep-seated domal-type structures in Fig. 5 of West Ganado

"Aerial photography covering the area to be surveyed is prepared with enough traverse to overlap the area. These traverse lines are flown by point-to-point visual navigation."

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oil field, Jackson County, Texas. This structure is considered to have been formed by deep-seated salt movement not yet encountered by drilling. The original surveys of the area[5] were completed in 1953 and the new surveys were conducted to determine whether the anomalies would repeat and also to secure additional pertinent information. The current survey illustrated in Fig. 5 was completed in February 1961. The two surveys are in substantial agreement in all important details.

Occurring northwest of West Ganado is another set of closed high-intensity field contours. A year after the original surveys were finished, a discovery was completed on July 16, 1954, establishing the SCAR gas field. This discovery supports the fact that a structural high exists as anticipated by the survey.

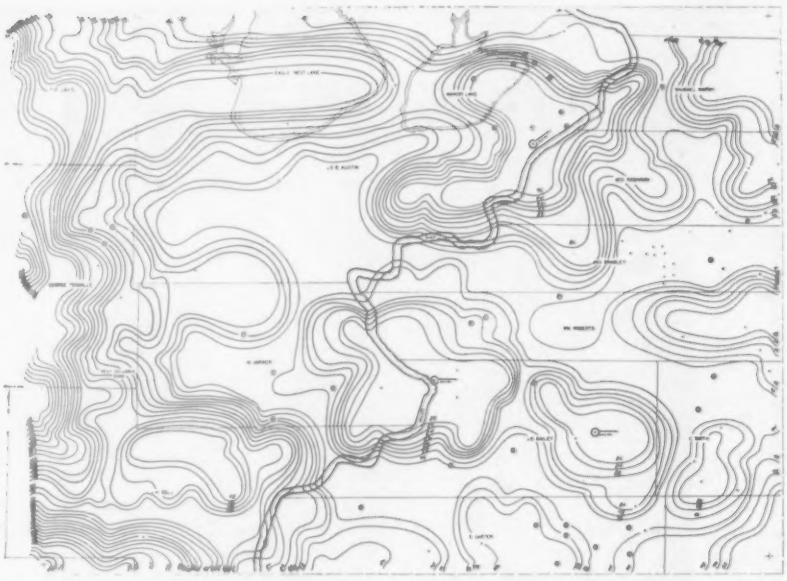
Manor Lake Area

The survey of the Manor Lake area, Brazoria County, Texas in Fig. 6 is an illustration of the results expected from this method of geophysical surveying in areas of complex faulting. The original survey was completed in February 1954, and the recent survey shown in Fig. 6, was done February 1961. The two agree in major details.

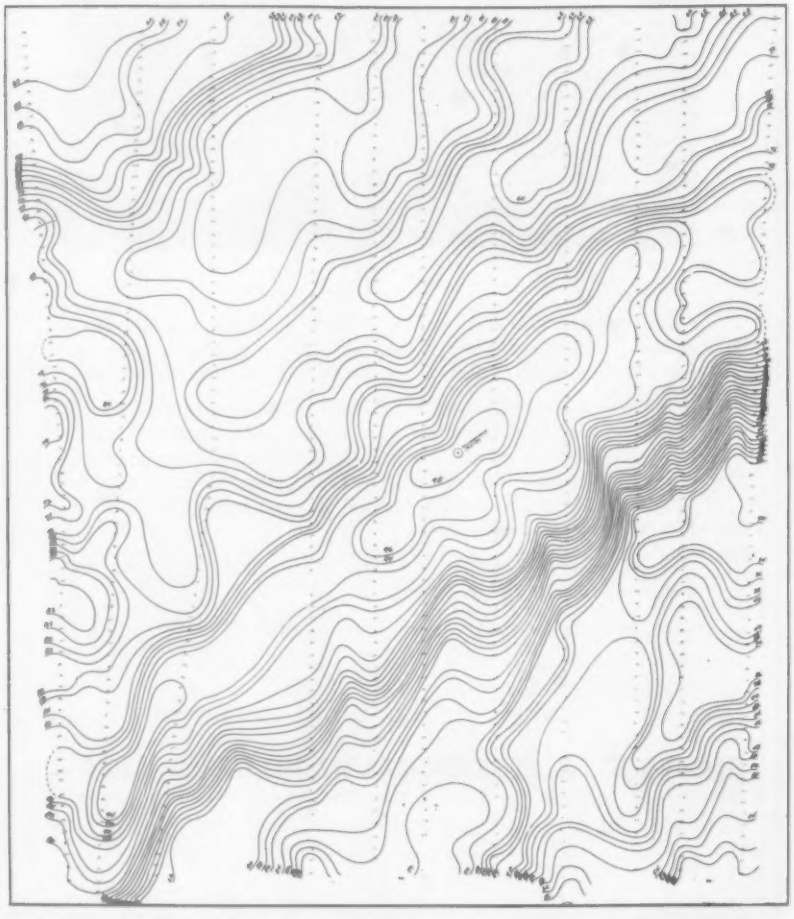
More than a year after the original survey was made a discovery[6] was made at Manor Lake field. Thirty-six wells have been drilled since the field was found (Fig. 6). The value of this geophysical method is seen in defining structural anomalies and their relationships.

Delaware Basin of West Texas

This airborne geophysical surveying method is useful for reconnaissance work as well as detailed surveying. To illustrate this method for reconnaissance, two 90-mile traverses were flown in the Delaware basin of West Texas. An anomaly occurring on one of the traverses was chosen for a detailed survey. The southwest Pecos area, Reeves County, Texas, is shown in Fig. 7. The survey map has 11 traverses that were flown together and the field-intensity values are shown along these traverses. The contours show a closed high-intensity field occurring near the center of the survey. Experience indicates that these contours reveal a high feature



THIS PORTION of Brazoria County, Texas, was flown to see what a complex faulted area would reveal. The surveying was done a year prior to the Manor Lake discovery and since then 36 wells have been drilled. Fig. 6.



THE ELEVEN TRAVERSES flown for this map were conducted to determine the reconnaissance value of the method. Results were good enough to warrant further detailing, if desired, but a location was recommended without further work. Fig. 7.

upon which a location has ben recommended.

Conclusions

With this method of surveying, 1,600 hours of flying time were required to map 140 areas. Forty-two of these were recommended for exploratory drilling. Thirty of the recommended anomalous areas were drilled, resulting in 20 discoveries of oil or gas condensate.

The mapped data produced significant anomalies which are consistently repeatable and are correlatable with certain types of geological structures. Advantages of airborne surveying are that terrain hazards and other problems frequently associated with ground crews are nonexistent, and the relatively economical cost of about 10 cents per acre for operation makes it very useful for both reconnaissance and detailed surveying.

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1. Federal Communications Commission, Washington 25, D. C.
2. Terman, F. E., Fundamentals of Radio, McGraw-Hill Book Co., New York, p. 48, 1938.
3. Terman, F. E., Radio Engineers Handbook, McGraw-Hill Book Co., New York, p. 697, 1943.
4. No. 1 is British Texas Oils, Ltd., Barber 1 well. No. 2 is General Crude Oil Co., Nash Fee 1 well.
5. Project No. 1-300-E, Southwest Research Institute, San Antonio.
6. Lion Oil Co. 1 Tri-State Investment Co., completed September 1955.

Gas pool discovered in California's Sutter County

In Sutter County, California, Buttes Gas & Oil Co. is testing an apparent new-pool gas discovery in the Marysville area.

The 17 Buttes-Carroll flowed at the rate of 2,500 M.c.f.d. through four perforations at 5,018 ft. The well also flowed 1,090 M.c.f.d. through a ⅜-in. choke during an open hole test at 4,818-40 ft. Further tests of the show are planned. The well went to a total depth of 7,000 ft. Location of the test is 32-16n-1e.

The wildcat is 1½ miles northwest of the 16 Buttes Community, a pool discovery well completed in March flowing 8 M.M.c.f.d. through a ½-in. choke from the Forbes zone at 4,360-4,442 ft. The test also is 2½ miles southeast of West Butte gas field.

Buttes holds leases on about 48,000 acres in this area.

Two gassers completed in Arkansas' Arkoma area

Two gas completions are reported on the Arkansas side of Arkoma basin. Stephens Production Co. completed 1 Eva and Tom Blakely in SE SW 27-9n-30w, Kibler field, Crawford County and Gulf Oil Corp. had a shallow find in Scranton field southern Johnson County.

The Crawford County well flowed 42,800 M.c.f.d. from dual zones in the Barton and Dunn sands. Barton perforations at 4,522-36 ft. got 8,800 M.c.f.d. through ¼-in. choke; the Dunn "A" sand and Ralph Barton sands at 4,369-92 and 4,396-4,402 ft. got 34 M.M.c.f.d. The well is offset to the north, east, west, and northwest by production. Stephens has five producers in the deeper zones of Kibler field. Other field gas is from shallow sands. Scranton. This Gulf well, 1 McAlester Fuel Co., C NW SE 31-9n-24w, north offset to the discovery well, flowed 2 M.M.c.f.d. on tests. Crew is drilling ahead below 3,650 ft. This pay sand is thought to be equivalent to lower Carpenter of Aetna field in Franklin and Logan counties, 10 miles southwest. The well is ⅞ mile north of the discovery well at Scranton which had Orr, Woolsey, and Hale production at 6,730 to 7,373 ft.

New pay completed in Canada's Raven River

In Alberta Champlin Oil & Refining Co. and Union Texas Natural Gas 6-5-35-5 W5 Raven River has been completed as a new pay discovery in the Cardium, flowing 167 bbl. per day of 45° oil through 24/64-in. choke. Top of the Cardium was encountered at 7,355 ft. and production is through perforations 7,374-84, 7,395-7,401 and 7,423-34 ft.

In the same well the Viking sand tested at the rate of 2.25 M.M.c.f.d. through perforations 8,363-67, 8,371-75 and 8,392-8,404 while the Mississippian Elkton tested a noncommercial amount of oil and gas on drill stem test 9,414-28. Both the Viking and Elkton had been proved productive in two previous wells completed by Champlain and Union Texas in the Raven River area.

The Cardium discovery is 5 miles southwest of Garrington Cardium field, 4 miles northwest of Elkton production at Sundre and 2 miles east of Caroline Basal Quartz gas field. Champlain and Union Texas have earned rights to 13 sections of Canadian Pacific Railway lands through a farmout from British American. The team is currently completing a Cardium well, the 11-27-35-5 Garrington, on another portion of the farmout lands and a continuous development program is planned for the Raven River area.

Big Denver basin discovery flows "D" sand oil

A good "D" sand Dakota Cretaceous oil discovery is reported in the Denver basin. Forest Oil Corp. completed 22-2 Dunne in C SW SE 22-4n-58w, Morgan County, flowing 480 bbl. of oil daily.

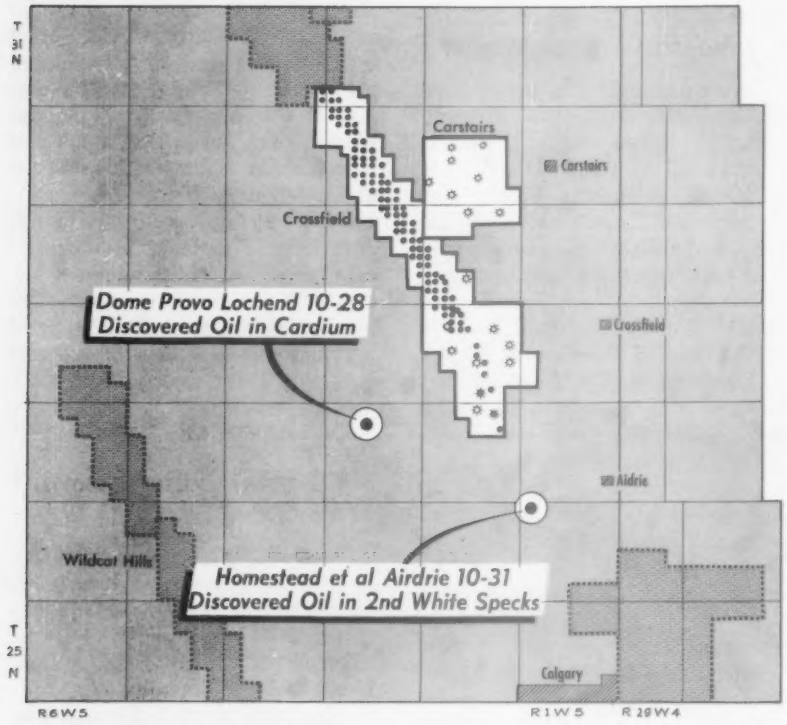
Flow was through ½-in. choke from "D" sand perforations at 5,764-75 ft. Location is 1½ miles southeast of Opal field and about 2 miles southwest of Young field, both "D" sand producers.

Three-wildcat program for southern Michigan announced

In Michigan, Hadson Oil & Gas Co. of Oklahoma City announced a three-wildcat program for southern Michigan including a projected 7,475-ft. St. Peter sand test, SW SW 22-5n-2e, Shiawassee County. If the projected depth is reached the Hadson wildcat would be the deepest in Michigan since 1956.

- Michigan Oil Co. 1 Mendham, SE SW NW 25-14n-16w, wildcat in Ferry Township, Oceana County, carried 1,500 M.c.f. gas in Berea sand at 1,505-10 ft. for potential gas-pool opener.

- Panhandle Eastern Pipe Line Co. 1 Schunk, NW NW NW 23-4n-16e, cored gas reef section in the Niagaran at 2,516-52 ft., and cemented 5-in. casing to bottom. Test appears a likely ½-mile south extension of the relatively new China-Indian Trails pool, one of several new reefs opened in eastern Michigan since the first of the year.



HERE IS one of Alberta's busiest areas . . . Crossfield. Cardium sand oil production highlights the trend known as Cardium Alley. Map from Daily Oil Bulletin.

Cardium finds keep mounting in Alberta

ALBERTA'S Cardium exploration continues to expand. Newest discovery in southern Alberta is Dome-Provo-Shell 10-28 Lochend, 8 miles west of the "Alley." That wildcat found 3½ ft. of pay. Operators are taking production tests. The well had flowed 102 bbl. of oil per day through 14/64-in. choke.

While the Cardium sand play is of biggest interest, Mississippian gas production is still being actively sought here, particularly in the east-central part of the trend. Cardium oil production in the trend area had been indicated through Mississippian wells in scattered spots along the 35-mile continuous trend over the past few years.

Last year fill-in drilling proved the presence of a continuous Cardium sand. Most believe the northwest part of the field has been developed, but the southeast limit has not yet been seen. Some believe it can go another 13 miles at least. A well at Shepard found a thin Cardium sand, but the operator abandoned the well. Another test is being drilled here which should be of great help in finding a southeast limit to the Crossfield trend.

East Texas discovery spurs action

RAPID DEVELOPMENT is planned for an indicated Sub-Clarksville oil discovery in southern Hopkins County, East Texas.

The discovery is Sinclair Oil & Gas Co. 1 J. R. Shelton in the E. Esparsa Survey, A-298, 3 miles north of Yantis, 3 miles northwest of Yantis field, and 4½ miles southwest of Como field, both Sub-Clarksville producers.

Crews are completing the discovery near 5,000 ft. Total depth was 13,823 ft. in Smackover Jurassic. R. S. Peveto et al. are drilling 1 J. C. Ogles in the Arnold Survey as a 4,500-ft. Sub-Clarksville test (Upper Cretaceous). Stephens & Moore Drilling Co. has contract. P. G. Lake Inc. of Tyler will drill three tests in the area. Two are slated south of the discovery in the E. Esparsa Survey, and one to the northeast in the Hayden Arnold Survey.

Sulphur Bluff confirmed. This Smackover discovery was confirmed at Gulf Oil Corp. 1 Holcomb et al. Gas unit, Wetmore Survey, A-1017. The well flowed 80 M.M.c.f.d. from perforations at 9,310-36 ft. It confirms the Hopkins County field, and lies ¾ mile southwest of the discovery well and 2 miles south of Sulphur Bluff.

Amerada 1 Bassham, J. A. Craft Survey, opened Smackover production here in 1958. The discovery well flowed 13 M.M.c.f.d. and 75 bbl. condensate per million from Smackover perforations at 9,324-29 ft.

Cal Noble. N. E. Formby completed a good oil well and south offset and confirmation to the discovery well of this eastern Rusk County field.

The 1 Rade Snelgrove, Henry Chapman Survey, flowed 157 bbl. of 40.5°-gravity oil daily through 9/64-in. choke from Pettet perforations at 6,891-6,900 ft. The well lies 660 ft. south of the field discovery well and 5 miles north of Pine Hill.

Just east of the confirmation discovery, B. G. Byars & Associates are coring the Pettet below 6,870 ft. at 1 Audie H. Brooks in the Henry Chapman Survey.

Cal Noble was a January discovery. Amigos Oil & Gas Co. 1 M. Duran, C. M. Gould Survey, A-321, flowed 85 bbl. of 40°-gravity oil daily through 17/64-in. choke to open the field. Production was from Pettet perforations at 6,895-98 ft.

New sites staked in Texas' Hopkins area

Expiring leases are causing a boom in Sub-Clarksville development around an oil find 3 miles north of Yantis in southern Hopkins County, East Texas.

During the past couple of weeks more than 15 new sites have been staked. The discovery causing this flurry of activity is Sinclair Oil & Gas Co. 1 J. R. Shelton in the E. Esparsa Survey, A-298. It pumped 58 bbl. of oil from the Coker sand at 4,270-76 ft. Nearest similar oil

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THIS HALLIBURTON TESTER is assembling the Hydro-Spring Tester in testing string before running a deep slim-hole test. He will provide a major oil company with formation pressures which the operator needs for reservoir evaluation. From this he will decide whether or not to case and complete the well.

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Test duration . . . . . 4 hours
Fluid recovered . . . 33.6 Sp. Gr. Crude @ 63 bbl flow during test through ¼″ surface choke
Tubing pressure . . . 650 psi
Tubing size . . . . . 2⅜″ O.D.
Oil to gas ratio 694/1

Second zone tested . . 9,200-9,216′ Cook Mountain Sand #2
Test duration . . . . . 2 hours
Fluid recovered . . . 34.2 Sp. Gr. Crude @ 47½ bbl flow during test through ¼″ surface choke
Tubing pressure . . . 1,075 psi
Tubing size . . . . . 2⅜″ O.D.
Oil to gas ratio 275/1

RELY ON FACTS IN FORMATION TESTING . .

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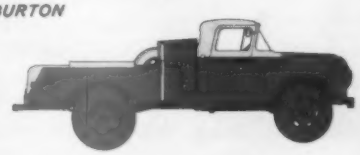

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is 4½ miles northeast in Como field.

R. S. Peveto et al. 1 J. G. Ogles, Hayden Arnold Survey, 3,000 ft. northeast of the discovery, was abandoned after going to 4,353 ft. Peveto et al. staked three more spots recently. P. G. Lake Inc. is drilling at three of five new locations staked here. The 1 Beville Estate, ½ mile east of the discovery well, is coring at 4,271 ft. Lake 1 Dink Bussy, ½ mile southwest of the discovery in the E. Esparsa Survey, A-293, is drilling at 4,108 ft. Lake abandoned the 1 W. A. Friddle in the Berry West Survey, A-1083. W. O. Davis Jr. & Associates staked 5 new locations and Sinclair began two more wells.

New Frio production tapped in Texas' Chocolate Bayou

General Crude Oil Co. has two gas-condensate producers in a new Frio sand in Chocolate Bayou field, Brazoria County, Texas Gulf Coast. The 1 and 3 wells of the Houston Farms Development Co. in the Perry and Austin Survey, A-110, 2 miles southeast of Chocolate Bayou town, found pay in new "P" sand. The 1 well flowed 21,950 M.c.f.d. from perforations at 12,505-14 ft. The 3 well flowed 11,900 M.c.f.d. from perforations at 12,510-18 ft.

South Texas. Luling Wilcox gas production is reported at South Rhode Ranch field, McMullen County. The Blair-Vreeland 1-C D. W. Rhode flowed 23 M.M.c.f.d. from Slick Wilcox 1-C perforations at 7,761-70 ft. Location is in Section 86, L. E. H. Spaulding Survey, A-910, 20 miles southwest of George West.

Texas has world's first oil-producing sextuple completion

WORLD'S first sextuple completion in which all the strings are capable of producing oil has been made by Humble Oil & Refining Co.

The sextuple, in King Ranch's Borregos field, South Texas, is similar to Sunray Mid-Continent's sextuple of a year ago except that its production is all oil—no gas (OGJ, May 23, 1960, p. 66).

The completion consists of three sets of 2⅞-in. casing, each with concentric tubing of 1½-in. Perforations are through the 7⅞-in. casing strings, and each string is then dually completed.

Humble presently is producing from five of the six zones tapped. The sixth is shut in but is capable of producing oil by gas lift or pump.

The well, the 167 King Ranch Borregos, is located 9 miles southwest of Kingsville in northwest Kleberg County.

The five producing zones have potentialed at 708 bbl. daily, flowing from the Frio oil sands. The zones are: (1) F-5 sand, perforated at 5,162-78 ft., flowing 159 bbl. daily through a 3/16-in. choke, with 950-psi. working pressure on the casing and GOR of 1,006:1; (2) N-4-7 sand, perforated at 5,187-92 ft., flowing 28 bbl. daily through a 3/16-in. choke, with 1,800 psi. flowing pressure and GOR of 49,-750:1; (3) N-17 sand, perforated at 6,350-58 ft., flowing 115 bbl. daily through a ⅜-in. choke, with 220 psi. flowing tubing pressure and GOR of 1,400:1; (4) N-19 sand, perforated at 6,377-82 ft., flowing 156 bbl. daily, plus 3% water, through a ⅜-in. choke, with 170

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psi. flowing tubing pressure and GOR of 1,183:1; and (5) N-21 sand, perforated at 6,405-19 ft., flowing 250 bbl. daily through a ⅜-in. choke, with 450 psi. tubing pressure and GOR 2,728:1.

The nonproducing sand is the J-3. Perforations are at 5,472-77 ft. The sand would not flow on test but is considered to be oil-productive by pump or gas lift.

Middle Frio gas discovery completed in Hidalgo, Tex.

Plymouth Oil Co. 1 D. J. Schwarz is a new gas discovery for Hidalgo County, South Texas. The well, 2 miles northeast of Progreso, flowed 5,200 M.c.f.d. on open flow from perforations at 8,548-54 ft. in the middle Frio. There was also some condensate. Location is in Share 5, Llano Grande Grant, 2 miles west of Santa Maria field.

DeWitt County. Standard of Texas 1 Louis Trautwein, 3 miles west of Arneckeville, flowed 8,400 M.c.f.d. plus condensate at the rate of 26,440:1 from perforations at 7,640-45 ft. in Wilcox. Location of the new discovery is northeast of Cottonwood Creek field and northwest of Arneckeville field in Charles Erambert Survey, A-172.

Palo Duro basin gets new Strawn production

An important oil discovery on the east end of the Palo Duro basin in northwestern Texas was completed by Kewanee Oil Co.

The 1 Sandifer, northeastern Foard County wildcat, was completed flowing 385 bbl. of oil daily plus 2.8% water through 16/64-in. choke from perforations at 4,228-93 ft. in the Strawn Pennsylvanian lime at 4,228-93 ft. Location of this important new field is in Section 369, Block A, H&TC Survey, 4½ miles east of Crowell and 6 miles southwest of Thalia field.

Red Fish Point adds third gas producer

A third producer has been added to Red Fish Point field in Vermilion Parish, South Louisiana, by Skelly Oil Co.

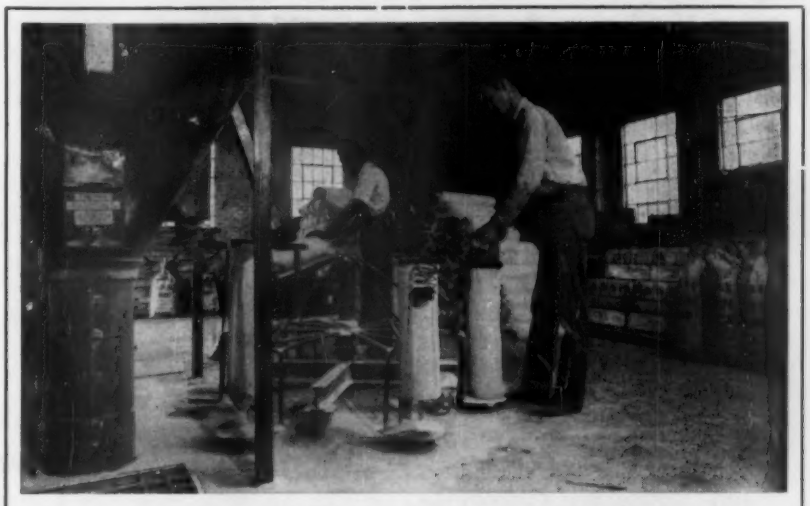
The Vermilion Bay well, 2 State Lease 3307, flowed 3,950 M.c.f.d. and 55 bbl. condensate from perforations at 15,360-15,446 ft. The field was a 1959 discovery by Gulf Oil Corp. at 1 State Lease 3306, a dual gas completion at 15,174-89 and 14,640-54 ft. Skelly confirmed the field at 1 State Lease 3307 at 15,470-80 and 14,990-15,000 ft.

Anadarko has oil find

AN IMPORTANT oil discovery for the Anadarko basin was completed by Mobil Oil Co. at 1 Dobbins in C SE NW 9-15n-15w, Custer County, Oklahoma.

This second oil find for the county flowed 436 bbl. of oil per day through 28/64-in. choke from perforations in the Oswego Pennsylvanian at 9,800-9 ft. The well had gone on down to the Hunton Siluro-Devonian at 14,405 ft. where some gas was found, but was plugged back.

Mobil earlier had found oil at 1 Horton in C SE NW 14-15n-15w. That well flowed 188 bbl. of oil daily through 10/64-in. choke from perforations at 9,722-78 ft. and 1,018 M.c.f.d. from Meramec at 13,192-13,360 ft. That discovery opened West Crane field.



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Extensive leasing activity increases in Appalachians

AN extensive land and lease play is under way in the Appalachian area.

Crews representing both major and independent oil firms are now working in Central and eastern Pennsylvania, West Virginia, western Maryland, and southwestern Virginia, with a few forays into extreme eastern Kentucky and eastern Tennessee.

As of May 1 more than 2,000,000 acres of commercial leases had been taken, and over 150,000 of federal lands, thus assuring the interest of the U. S. Department of the Interior in the new Appalachian drive.

Shell Oil Co. is reportedly pacing the campaign with at least 70 leasers after tracts, large and small, and Mobil Oil Co. is second. Others active are Sun Oil Co., Ohio Oil Co., Tidewater Oil Co., Humble Oil & Refining Co., Kerr-McGee Oil Industries, Inc., Pure Oil Co., Phillips Petroleum Co., and E. Willis Germany of Dallas.

A study of the different leasing methods showed one company to be playing the flanks of old producing structures, while others pursued their campaign in far-flung fashion. One firm was making a concerted effort to find vacancies in the blocks of all of the companies.

Seismograph Service Corp., Tulsa, had been employed to conduct a study of the region, it was reported.

Most of the public gas utilities have held protective acreage on structures in Pennsylvania for a number of years. Except for Erie and Crawford counties very little acreage is available in western Pennsylvania since most of the land in this section of the state has been leased for years. The recent Oriskany and Medina plays in Erie and Crawford counties have caused most of the acreage in these two counties to be leased in the last 2 years.

At the close of 1960 and during the first few months of 1961 considerable leasing took place in Bedford, Fulton, Perry, Snyder, Northumberland, Luzerne, Carbon, and Monroe counties in Pennsylvania. As of now the leasing is tapering off. Some of the companies have recently shown some interest in the shallow oil fields of Pennsylvania.

Ohio. More acreage is now held under oil and gas lease in Ohio than in many years. Of the 4,500,000 acres under lease, approximately three-fourths of this total is held by operators not previously represented in the past 3 or 4 years. Practically all the 88 counties with the exception of a few counties in the west-central portion of the state are represented.

Kewanee Oil Co. leased several hundred thousand acres in the south-central area and started testing blocks in 1957. Since then, majors who have staffed offices in the Appalachian area and indicated their interest in the state by leasing and joining with others, in exploratory tests include: Gulf Oil, Phillips Petroleum, Northern Natural, Humble Oil, Mobil Oil, Sun Oil, Continental Oil, Shell Oil, Atlas Exploration, and both El Paso Natural Gas and El Paso Products Co. Pure Oil and Ohio Oil, who won production in the state, have also extended their operations. Ohio Fuel Gas, East Ohio Gas, and Lake Shore Pipeline Co. already in possession of considerable blocks are active in participation on a joint basis with newcomers.

Six producers to date in a zone previously untested (Cambro-Ordovician), the hope of extending the southern Michigan play, and the Clinton successes in northeastern Ohio have all proved attractive. Reasonable drilling depths and lack of proration regulations have also undoubtedly led to interest here. Interest in state-owned or controlled lands is marked; the State Division of Shore Erosion has sent out a procedure to major producers and interested parties, detailing regulations for leasing areas in Lake Erie.

Indications appear very favorable for a busy year of exploratory operations in the Clinton and sub-Clinton horizons.

Once-wild Canada well capped for gas

Pan American Petroleum Corp. has capped another potential gas success in the general Berland River district of Central West Alberta, 175 miles west-northwest of Edmonton.

This particular well blew out of control earlier this year and an ensuing fire completely demolished the drilling rig. "Red" Adair, the internationally known fire fighter of Houston, was called in to control the well at that time. After it was brought under control, a new drilling rig was moved to the well site and operations resumed. However, an unrecoverable fish in the bottom section of the hole prohibited further drilling and consequently a portion of the hole was lost, a whipstock set, and a new hole started to carry it back into the pay sector. It is estimated that through that whipstock job the hole from which it will now be produced is less than 15 ft. from the scrapped portion of the old hole.

Grizzly. The strike, Pan American 14-3-61-22 B-3 Grizzly, on LSD 14, 3-61-22w5, is ½-mile south of another successful gas well—the Pan American 6-10 B-2 Grizzly venture that found product in the Gething horizon but failed to yield from the D3 horizon. Another venture drilled by Pan American 5-8 Grizzly is 2½ miles northwest. That hole found a thin D3 gas section as well as the Gething gas. The B.A.-Shell A8-4 Berland D3 discovery well is near, lying 14 miles south-southwest. It was completed from the same section in which the new well has indicated success and contains a calculated open-flow potential in excess of 1½ billion cubic feet daily.

The new discovery has not been tested as yet but it was estimated during the fire, that gas flow from the reef, with drill pipe in the hole, was 10 M.M.c.f.d. From logs it is estimated that there is a 54-ft. net pay section in the horizon.

The original well was drilled to total depth of 11,077 ft. and initial whipstock was set at 10,962 ft. The whipstocked portion of the hole was carried to bottom at 11,175

ft. and plugged back to 11,100 ft. Production casing, 5½ in. in diameter was landed at 11,145 ft. and packers were set at 10,973 ft. and 10,962 ft. Reef top in the whipstocked hole was picked at 11,022 ft. and the water line at 11,076 ft.

The venture is wholly owned by Pan American as it lies within the confines of Petroleum and Natural Gas Reservation No. 1773. That tract contains a total of 99,840 acres in the immediate vicinity of the success.

Second Smackover well finaled at Haynesville, La.

A dual completion added the second Smackover Jurassic oil producer to the new area in old Haynesville field, northern Claiborne Parish, North Louisiana. The well is Tenneco Corp. 1 Taylor, 3-23n-8w.

Well flowed 256 bbl. of 49.8°-gravity oil daily through 9/64-in. choke from Smackover "B" zone perforations at 9,952-81 ft. and 223 bbl. per day through 14/64-in. choke, 0.2% bottom sediment and water from "C" sand perforations at 10,407-33 ft. This producer could also have oil production from the Cotton Valley Camp sand. Recovery on drill-stem test at 7,977-90 ft. was 7,900 ft. of 43°-gravity oil.

Ouachita Parish. Southwest Natural Production Co. and B. E. Gamble completed 1 Bacon in C NW SW NW 10-17n-2e, 3¼ miles northeast of Cadeville field in Ouachita Parish, North Louisiana, flowing 525 bbl. of condensate and 4,500 M.c.f.d. through 14/64-in. choke. Production is from a new Cadeville sand of Cotton Valley Jurassic age at 9,683-98 ft. Location is 4¾ miles southeast of prolific production at Calhoun field.

Oil pay tapped in Nebraska's Dundy County

In Nebraska Sunray Mid-Continent Oil Co. has tapped production at an exploratory well in Dundy County.

Located 2½ miles northeast of Indian Creek pool, Sunray's 1 Ham, C NW SE 29-3n-37w, pumped 68 bbl. of 30-gravity oil a day from Lansing-Kansas City perforations at 4,216-24 ft., 4,254-60 ft., 4,355-64 ft. and 4,380-87 ft. Total depth was 5,062 ft. with 4½-in. casing cemented at 4,487 ft.

Sunray has finaled 1 Frank Fox, C SW NE 18-1n-28eCM, as a dual gas well in Beaver County, Oklahoma.

The well flowed 8,060 M.c.f.d. through ¾-in. choke from upper Morrow perforations at 8,312-42 ft. Tubing pressure registered 850 lb. Deeper in the hole, perforations at 8,450-68 ft. opposite the lower Morrow flowed 4,260 M.c.f.d. through ¾-in. choke. The hole was drilled to 8,660 ft. with 4½-in. casing cemented 1 ft. off bottom.

Action flares in three Rocky Mountain areas

Red Willow County, the busiest area in Nebraska, gained another oil field at Tipps Drilling Co.-Sage Oil Co. 1 Haag, C NE NE 31-2n-26w.

The well pumped 96 bbl. per day, cut 1% water, from Lansing-Kansas City Pennsylvanian perforations at 3,270 and 3,440 ft. Location is 2¼ miles southeast of Silver Creek Pennsylvanian production.

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in Sublette County, Green River basin, is Belco Petroleum Corp. 14 Unit in SE SW 20-27n-112w.

The well was completed for a calculated absolute open flow of 57,150 M.c.f.d. from second Frontier Cretaceous perforations at 6,891-7,164 ft. The discovery well on this block, drilled in 1959, Pan American Petroleum Corp. 1 Unit, C SW NE 19-27n-112w, flowed 919 M.c.f.d. through 16/64-in. choke from 7,606-56 ft.

Montana. Murphy Corp. completed 1-B Sethrie in Tule Creek field, Roosevelt County, NW NW 20-30n-48e. It pumped 44 bbl. of oil and 10 bbl. water daily from Nisku Devonian perforations at 7,686-91 ft. This is the field's sixth producer. The new well is a southeast offset to the field discovery well and is the southeasternmost well in the field.

Sinclair Oil & Gas Co. completed 1 Hansen in C SE NE 24-32n-58e, Sheridan County. It pumped 430 bbl. per day from Ratcliffe Madison Mississippian perforations at 7,755-57 and 7,781-83 ft., adding a northwestern producer to Dwyer field. It is the east offset to Signal Drilling & Exploration Co. 1 Olson in C SE NW 24-32n-58e, a northwest outpost to the field. That well flowed 272 bbl. per day.

New Mexico condensate well completed

An important Pennsylvanian gas-condensate discovery was completed by Continental Oil Co. at 3-18 Table Mesa, C SE NW 3-27n-17w, Table Mesa field, San Juan County, San Juan basin, northwestern New Mexico.

The well flowed 21,500 M.c.f.d. plus 15.5 bbl. condensate per million. Present market outlet limits daily output here to 2 M.M.c.f.d. and 31 bbl. condensate daily. Production is from perforations in the lower Barker Creek zone of the Paradox Pennsylvanian through perforations at 7,097-7,113 ft. The field's main pay is the Dakota sandstone of Cretaceous age, found in 1925. In 1955 Continental drilled 17 Table Mesa in 3-27n-17w, making 21,688 bbl. of oil from the Mississippian before going to water. They tried to make a Pennsylvanian well out of it but failed. Gas in the new well is 5.4% helium.

Drillers probe for Ohio's sub-Clinton

In Ohio, considerable interest is focused on several sub-Clinton tests drilling in scattered areas of the state.

El Paso Natural Gas Co. 1 W. & M. Brenner, Section 4, Smith Township., Mahoning County had gas pays in the Clinton, Trenton, and Trempeleau. Rotary tools made 8,031 ft. of hole in 26 days and pays are now being tested.

Russel Graber 1 G. Courtwright, Section 9, a mile offset to a small Cambro-Ordovician producer in Violet Township, Fairfield County is being acidized. It made 2 gal. of oil an hour natural.

In Mary Ann Township, Licking County, Lake Shore Pipe Line Co. 1 L. P. Crowley, Lot 15, is drilling at 5,385 ft.

And a scheduled granite test, Lake Shore, Gulf, and Sun Oil 1 W. R. Marshall, Section 15, Adams Township, Guernsey County is drilling at 8,142 ft.

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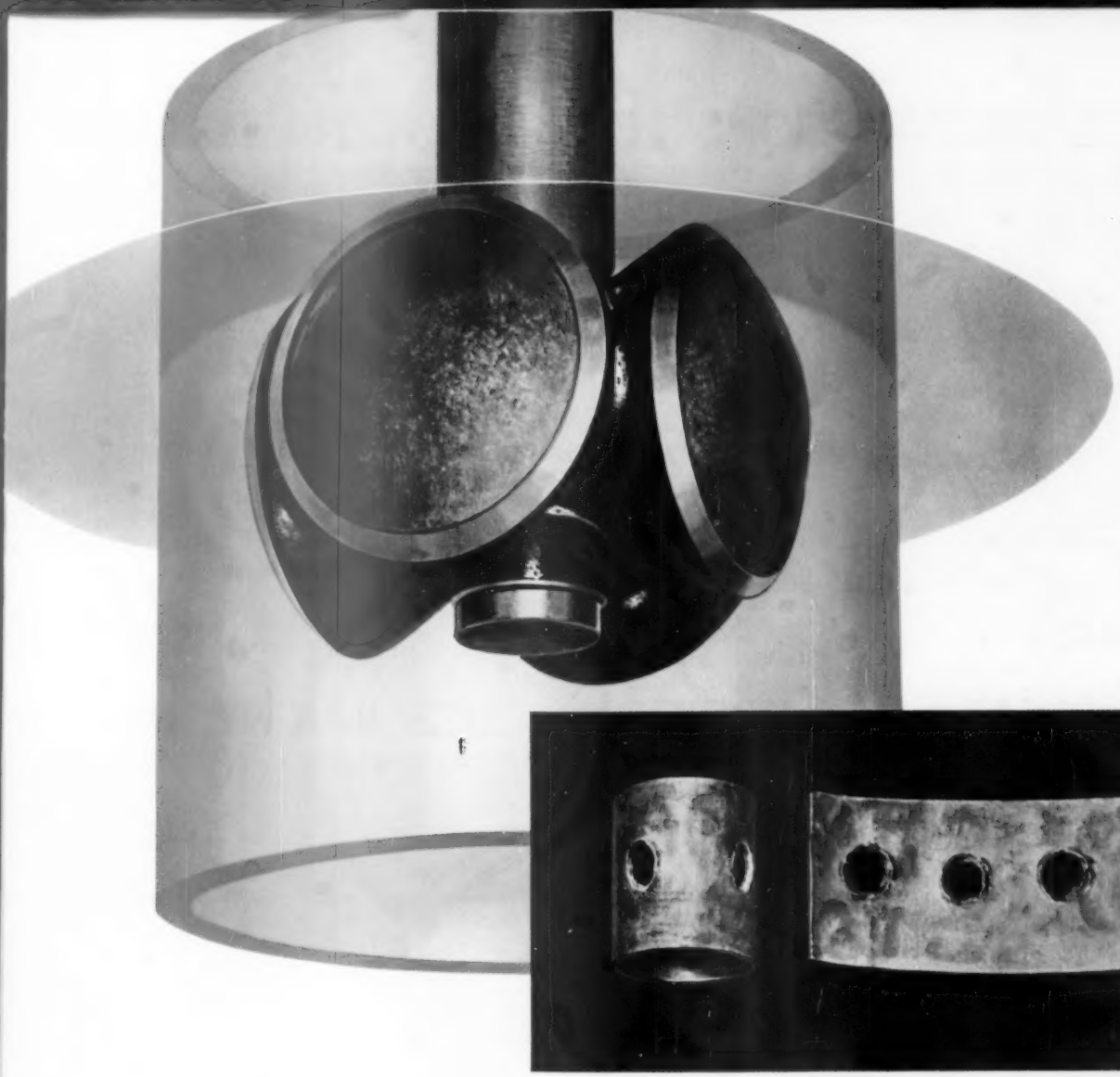

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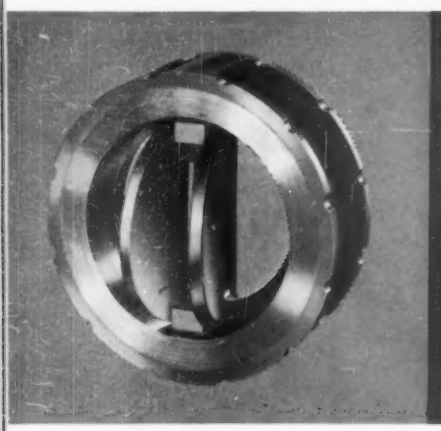
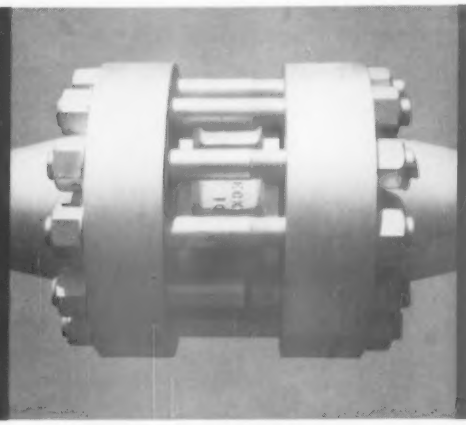
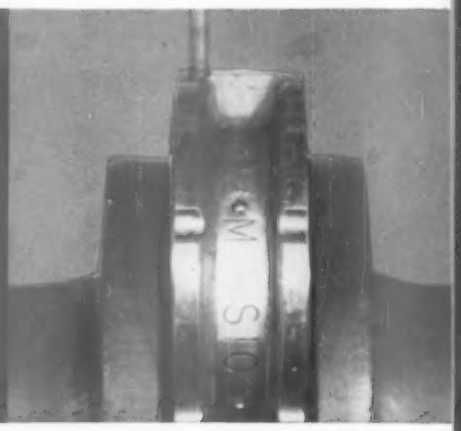


Because of its sound, imaginative design, the Duo-Chek check valve is smaller, uses less material, and costs less to buy. It costs less to maintain and lasts longer, too.



A Duo-Chek check valve weighs on the average less than ten per cent, with some models weighing only two per cent, as much as conventional check valves for the same service. No foundations are needed.



The Duo-Chek fits between the flanges, is smaller and weighs less. For example, a 6-inch steel valve, series 300, weighs 29 lbs., requires no special installation equipment.

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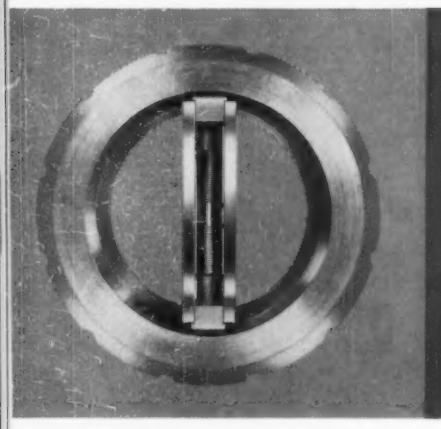
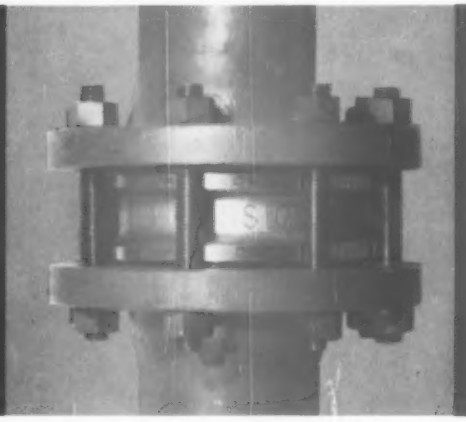
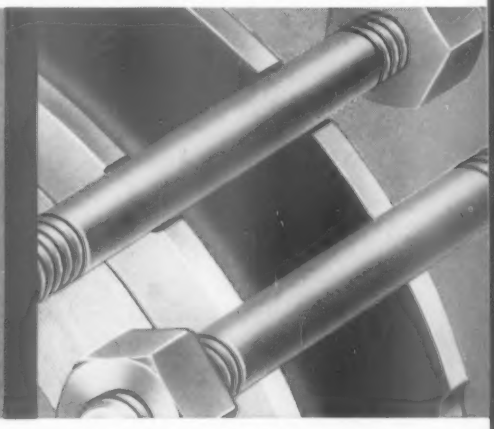


A stainless steel coil spring effects positive sealing action. The quick action of the spring closes the valve before reverse flow can occur. Result: No slam, no water hammer.



The Duo-Chek simplifies piping arrangements. The spring loaded plates operate in any position. Most popular sizes can be installed even in vertical lines with downward flow.



The unique versatility of the Duo-Chek greatly reduces inventory. In sizes 2 through 12 inch, one valve fits both series 150 and 300 flanges; 2- and 3-inch sizes fit series 600, too.

MISSION **DUO-CHEK** CHECK VALVE

The Mission Duo-Chek® check valve performs all regular check valve duties, yet is smaller, lighter, and easier to install. Duo-Chek check valves are available in a complete range of sizes from 2 to 48 inches, ASA Series 125 through 2500. They come in various end connections, such as raised face, ring joint, weld neck, etc. They are made in carbon steel, stainless steel, aluminum, and bronze. Special alloys are available. Because of the small size of the Duo-Chek, special alloy valves cost much less than conventional valves in the same alloy.

Sealing material is bonded in a groove in the plate. The sealing material makes an O-ring seal, which pressure deforms until metal-to-metal contact is made by the plate and body seat. Sealing material may be Buna-N, Teflon, Viton, or metal, depending on the service.

The simplicity of design of the Duo-Chek pays off in every installation with longer life and less maintenance. Only six parts are contained within the body of the Duo-Chek, held without the use of internal fasteners or joints of any kind. All parts are interchangeable.

The Duo-Chek is much lighter in weight than conventional check valves, yet is stronger. By dividing the opening, the unsupported plate area is reduced so that each plate requires only one-eighth of the weight of a conventional clapper of the same strength. The short stocky body is inherently stronger and more rigid than a short length of heavy wall pipe.

Whatever your check valve application, the Mission Duo-Chek can cut initial purchase and installation costs, cut maintenance costs from then on. Contact Mission now for a representative.

MISSION VALVE AND PUMP CO. A SUBSIDIARY OF MISSION MANUFACTURING CO. P. O. Box 4209, Houston, Texas • Cable Address "MISSCO" • Export Office: 30 Rockefeller Plaza, New York • In the United Kingdom: MISSION MANUFACTURING CO., LTD., 1 Hanover Square, London W. 1 England • Cable Address "MISSOMAN" • Sold by Mission Manufacturing Company outside of Canada and the U.S.A.

MISSION VALVE AND PUMP CO.

For explorationists' reading:

Yearbook available

A two-volume statistical and graphical summary of 1960 well information, compiled and edited by the staff of Rinehart Oil News Co.'s special publications department, is now ready for distribution. This data-filled series covers all discovery wells and other pertinent drilling data throughout the country for last year. A complete list of discovery wells, state maps, important dry holes, graphs, tables, pool maps, and a running story of what happened in each oil and gas area of the country makes this publication an important addition to those watching oil data. Order from Rinehart Oil News Co., Box 1208, Dallas 21, Texas.

New publication available from North Dakota Geological Society

The North Dakota Geological Society, Box 1123, Bismarck, has released its latest contribution to the geology of the Williston basin . . . "Stratigraphy of the Williston Basin-Devonian System." This complete discussion of the Devonian system of the basin includes a reference well and correlation chart, isopachous maps of the Elk Point, Manitoba, Jefferson, and Three Forks formations, and a fold out cross-section of South Dakota to Saskatchewan.

Oklahoma volume has structure maps, isopachs

An important new book of special interest to operators with Oklahoma oil and gas interests has just been published by National Petroleum Bibliography, Box 3586, Amarillo.

Titled "Geological Maps—Oklahoma Oil & Gas," the new book is the first reference work to cover structure maps and isopachs of producing areas over the entire state.

More than 500 maps, with a wealth of geological and production data, are carried in the book's 342 pages of unusually large size. Each map is indexed alphabetically by field, then is listed separately in a county index.

Hardbound in beautiful royal-blue leathercloth, with solid-gold lettering and brass corners for long wear, the book is the result of intensive evaluation of public records in the Oil and Gas Division, Oklahoma Corporation Commission. More than 7,000 hearing files, covering the period 1955-1961, were examined during its compilation.

California-Alaska map book ready

The 1961 edition of Munger's map book of oil and gas fields in California and Alaska is now available.

The 220-page book carries maps of all fields in the two states and has information updated to March 15. All wells drilling as of March 15 are shown in the book as well as completed and dry holes.

Among the areas covered in this new Munger book is the Kenai Peninsula of Alaska. The book also has the latest maps available on the offshore play in the tidelands off Santa Barbara County, California.

The book sells for $20 and is available at Munger's Los Angeles office, 5865 West Boulevard.

Discovery wells

COLORADO

Logan County:

Pfeifer Oil & Gas Co. 1 Budin, C SW NE 12-8n-55w. IPP 148 BOPD, cut 10% water, "J" sand 5,318-20 ft., OWWO. OTD 5,369 ft. TD 5,369 ft.

NEBRASKA

Cheyenne County, Emerald:

Ohio Oil Co. 1 Neilsen, C SE NE 8-14n-52w. IPP 80 BOPD, 60% water, "J" sand 5,267-74 ft. TD 5,355 ft. "J" sand discovery, new field.

Harlan County, Prairie Dog Creek:

Buick Drilling Co. and Pat Simmons 1 Johnson, SW SW 14-1n-18w. IPP 40 BOPD, Lansing-Kansas City discovery, new field. TD 3,545 ft. Lansing-Kansas City 3,366-3,470 ft.

OKLAHOMA

Atoka County:

Willis Petroleum and A. G. Blauner 1 Minnie Phillips, NW NW NW 17-3s-10e, 2 miles southeast of Boggy Depot field. IPP 7 BOPD, 29°, Atoka sand 650-822 ft. TD 1,004 ft. New oil discovery.

Garfield County:

National Associated Petroleum Corp. 1 Gabriel, ¾ mile east of Meramec field in C NE NE 27-20n-6w. IPF 235 BOPD, 30/64-in. choke, FTP 200 psi., 38°, Meramec open hole 6,631-6,742 ft. TD 6,742 ft. New oil discovery.

Major County:

Pan American Petroleum Corp. 1 Nichols unit, SE NW 35-20n-12w, 6 miles south of Fairfield. IPCOF 735 M.c.f.d., Chester 7,530-82 ft. TD 9,410 ft. New gas discovery.

SOUTH TEXAS

Calhoun County:

East Zoller. Lamar Hunt 1 State Tract 79, 8 miles southeast of Austwell in St. Tr. 79, San Antonio Bay. IPAOF 36,500 M.c.f.d., SITP 4,407 psi., 53.2°. GOR 20,900:1, BHPSI 5,660 psi. Frio "G" sand 9,007-14 and 9,022-34 ft. TD 11,805 ft. New gas-condensate discovery.

East Zoller. Lamar Hunt 1 State Tract 96, St. Tr. 96, San Antonio Bay. IPAOF 1,150 M.c.f.d., SITP 3,716 psi., 54°, GRL 8,620:1, BHPSI 5,268 ft. Frio "F" pay 8,828-34 ft. TD 11,439 ft. New gas discovery.

Mayfair Minerals, Inc. et al. 1 Marjorie Holland Smith et al., 9 miles west of Port Lavaca in Manual Venitez Sur., A-39. IPAOF 12 M.M.c.f.d., SITP 3,203 psi., 59.3°, GLR 20,600:1, BHPSI 4,128 psi., Frio 9,452-54 and 9,558-63 ft. TD 10,120 ft. New gas-condensate discovery.

Edwards County:

Tucker Drilling Co., Inc. et al. 1-A W. L. Miers et ux, 22 miles northwest of Rocksprings in Lge. 2, Menard CSL Sur. IPAOF 2,120 M.c.f.d., SITP 423 psi., dry gas, Cisco 2,222-36 ft. TD 6,023 ft. New gas discovery.

Tucker et al. 1 W. L. Miers et ux, 20 miles northwest of Rocksprings in Lge. 3, Menard CSL Sur. IPAOF 3 M.M. c.f.d., Cisco 2,364-76 ft. SITP 575 psi., dry gas. TD 6,220 ft. New gas discovery.

Jim Wells County:

Gust Tsesmelis 1 Mauricio Lopez, 10 miles north of San Diego in San Diego de Abajo Grant, A-155. IPAOF 1,200 M.c.f.d., SITP 725 psi., BHPSI 804 psi., dry gas, Hockley 4,749-50 ft. TD 5,010 ft. New gas discovery.

LaSalle County:

Rainbow. C. L. Buzz Morgan 2-112 South Texas Syndicate, 12 miles southeast of Los Angeles in Sec. 112, H&GN Sur., A-1343. IPF 30 M.M.c.f.d., SITP 1,935 psi., 68.5°, GLR 94,000:1, Wilcox 5,071-75 ft. TD 5,654 ft. IPF 11,600 M.c.f.d., SICP 1,622 psi., dry gas, Wilcox 4,616-19 and 4,622-26 ft. Dual gas and gas-condensate discovery.

Jackson County:

South Texana 6,370-ft. field. Carthay Land Co. et al. 1 W. C. Simons et al., 3 miles northwest of Lolita in F. F. Wells Sur., A-78. IPF 141 BOPD, no water, P-36 choke, TP 765 psi., 39.8°, GOR 640:1, Frio 6,367-75 ft. TD 7,516 ft. New oil discovery.

WEST CENTRAL TEXAS

Coleman County, prorated in Regular field:

James O. Jones 1 R. O. Matthews, 1½ miles southeast of Santa Anna in Sec. 60, HT&B Sur. IPP 40 BOPD, plus 30% water, 42°, GOR 200:1. Breneke sand 1,607-10 and 1,611-14 ft. TD 1,691 ft. New oil discovery.

Palo Pinto County:

Fletcher Oil & Gas Drilling Corp. 3-A Ellie H. Wibar Est., 1 mile west of Gordon in J. Latham Sur. A-279. IPCAOF 3,400 M.c.f.d., Strawn 1,710-22 ft. TD 2,000 ft. New gas discovery.

4-A Ellie H. Wibar Est., 1 mile west of Gordon in J. Latham Sur. A-279. IPCAOF 1,200 M.c.f.d., Strawn 1,539-51 ft. TD 1,999 ft. New gas discovery.

▶ ▶ ▶ Personals

Alfredo Federico Bracht, Argentine financier and business executive, has been named president of Petroquimica Argentina, SA (PASA). **Dr. Wesley S. Coe,** former director of research and develop-

BRACHT

COE

ment for Naugtuck Chemical division of U. S. Rubber Co., has been named managing director of the new firm. Petroquimica Argentina plans to build a $70 million petrochemical complex in Santa Fe Province. Products will be synthetic rubber, benzene and chemical intermediates. Owners of PASA are Continental Oil Co., U. S. Rubber, Cities Service Oil Co., Fish International Corp., and Witco Chemical Co.

E. C. Taber, manager of planning in Shell Oil Co.'s New York head office exploration department, has been given a temporary assignment in Houston as area exploration manager. He takes over this post for **J. W. Inkster,** who has been given an extended assignment at The Hague. **E. J. Strawn,** area transport manager in Houston, has been given a special assignment for the head office exploration and production organization, but will continue to headquarter in Houston. **R. H. Hurd,** New Orleans, will replace Strawn.

Richard A. Bray, associate geologist with Humble Oil & Refining Co., has been transferred to New Orleans from Tallahassee, Fla.

C. W. Laas has been transferred by Gulf Oil Corp. from Shreveport, La., to Laurel, Miss., where he will be area drilling foreman.

Edward O. Roe, research engineer with Jersey Production Research Co. in Tulsa, has joined United Geophysical Corp. as development engineer.

Dick Finn, head of the additives section of Humble's Enjay Laboratories, Linden, N. J., has been named head of the butyl nontransport section. He succeeds **Walter Gleason,** who has been named sales technical-service coordinator of Esso International. **Gordon Seeler,** Enjay Chemical, will replace Finn in the Enjay Laboratories additives section.

Edmund Davidson and **Theodore Vogel** have joined Esso Research & Engineering Co. as chemists in the chemical-research division. New chemical engineers with the company include **Eugene Castagna,** technical sales; **Edgar Kluge,** mechanical division; **William Ellis,** process engineering; **Joseph Wagensommer** and **Dennis Poller,** chemicals-research division.

Charles M. Hamilton, Jr., has been named chief process engineer at AviSun Corp.'s polypropylene plant now under construction at New Castle, Del.

J. Blaine Miller, geologist in Gulf Oil Corp.'s Bismarck, N. D., office, has been transferred to Oklahoma City. **Jack Balderas,** Bismarck, has been transferred to Denver as geologist. Gulf's Bismarck office has been closed.

Lowell E. Anderson, division chief engineer on special assignment in Tulsa for Service Pipe Line Co., has been promoted to technical supervisor of stations. He succeeds **F. V. Cook,** who has retired after 41 years with the company. Anderson will take over his new duties after completing an assignment as construction manager on Dixie Pipeline Co.'s eastern section. Service, one of the owners of Dixie, is doing construction and design work on the new LPG line.

ANDERSON

Roger H. Newton has joined H. C. Schutt & Associates, Boston consulting firm.

Raymond D. Woods has been named to succeed **Dr. Parke Dickey** as manager of of Jersey Production Research Co.'s geological research

WOODS

DICKEY

division in Tulsa. Dr. Dickey will do independent geological research for Jersey at the Tulsa research laboratory. Woods has been coordinator of the geological research section at Humble's Houston research center. He had been with Humble since 1934. Dickey has headed Jersey Production's geological research division since 1958.

Bill Brandorff, Continental Oil Co., has been elected secretary of Wyoming Geological Association. He succeeds **Leonard Taucher,** Richfield Oil Corp. Taucher is being transferred to Salt Lake City from Casper, Wyo.

Doyle S. Smith, assistant manager of Continental Oil Co.'s transportation department, has been promoted to department manager. He will continue to headquarter in Ponca City, Okla. Smith succeeds **C. O. Reeder,** who has retired.

Wilbur R. Phillips has been named superintendent of Sid Richardson Gasoline Co.'s Kermit, Tex., gasoline plant. He succeeds **Shelby Lee (Cap) Humphreys,** who has retired after 12 years with the company. Phillips was with Pecos Co. and Denton Oil Co. in Lubbock, Tex., before joining the Richardson firm recently.

John Skvarla, head of the short-range economics group in the economics and design division of Humble's Bayway refinery, Linden, N. J., has been named unit supervisor in the additives division at Bayway. **Harry Burks** will succeed Skvarla in economics and design. Burks recently has been on loan assignment with the supply department in New York. He was senior engineer in supply and distribution at Bayway before the New York assignment.

Saied Naghavi, head of engineering and technical-services for National Iranian Oil Co., has been elected a director of NIOC.

Garland E. Wheeler, exploration geologist for Standard Oil Co. of Texas in Amarillo, Tex., has been transferred to Snyder, Tex., as development geologist.

Charles M. McKay has been named general manager of United Carbon Co.'s Baytown, Tex., synthetic rubber plant.

W. T. Hudson, consulting geologist in Phoenix, has moved his offices to Denver. He will specialize in helium.

K. A. Anderson, engineer with H. B. Zachry Co., San Antonio, Tex., has been transferred to Burlington, Kans., from San Antonio.

Cecil E. Loomis, president and a director of Columbia Gas System, Inc., has been elected vice chairman of the company. He will continue as chief administrative officer. **John W. Partridge,** president of the Charleston group companies of the

LOOMIS

PARTRIDGE

system, will succeed Loomis as president of the parent company. **Fred W. Batten,** vice president and chief operations officer of Columbia, has been elected senior vice president, chief operations officer, and a director. **Francis H. Crissman,** Columbia vice president and chief financial officer, has also been elected a senior vice president. He will continue as chief financial officer. **James S. Phillips,** vice president and general manager of the Charleston group companies, will succeed Partridge as president of these companies.

Kenneth A. Wallace has joined Canadian Homestead Oils as staff geologist in Calgary. He had been with Mobil Oil of Canada.

Thompson Dawkins Winters

Thompson Is Elected PEPA President

B. F. Thompson, Public Service Co. of Oklahoma, was elected president of Petroleum Electric Power Association at the annual meeting last week in Tulsa. Thompson, who served as PEPA vice president last year, succeeds W. M. Larkin of Gulf States Utilities Co.

Other new officers are Kirby Dawkins, West Texas Utilities Co., vice president, and H. R. Winters, Oklahoma Gas & Electric Co., secretary-treasurer.

Thompson and Larkin are among new directors elected by the association and Winters is a holdover director. Other new directors include R. W. Williams, Community Public Service Co.; Roger Owen, Southwestern Public Service Co.; Harold May, Kansas Gas & Electric Co.; and Bill Ohrman, Texas Power & Light Co.

A. A. Hopkins, Jr., formerly of Bakersfield, Calif., is president of Sacramento Oil & Gas Co., Beverly Hills, new California exploration company. **Paul C. Nelson** is vice president and **Frank P. Barton** is secretary of the new company.

Rex Alford, administrative assistant in Continental Oil Co.'s Catco marine region, has been promoted to assistant to the manager of Conoco's headquarters production department. He will continue to headquarter in Houston. Alford was with Mene Grande Oil Co. in Venezuela before joining Conoco in 1956.

Harold Aab, Farmington, N. M., district superintendent for Skelly Oil Co., has been named superintendent of the Hobbs, N. M., production district. He succeeds **James N. Dunlavey,** who has retired after 37 years with Skelly. Dunlavey plans to set up independent operations in Roswell, N. M.

Wallace W. March, managing director and a founder of International Drilling Co., has retired.

Purdom C. Thomas, vice president in charge of Shell Oil Co.'s Midwest marketing divisions in Chicago, has been named vice president of national marketing. He succeeds **J. G. Jordan,** who will retire December 31 after 36 years with Shell. Thomas' appointment is effective July 1. Jordan will become marketing consultant to the president until his retirement. **Jack H. Hall,** general manager of head office marketing, will succeed Thomas in Chicago.

THOMAS

Personals

William McBee, Jr., has joined Lion Oil Co. division of Monstanto Chemical Co. as resident geologist for the southern exploration region, Shreveport, La. **Norman R. Abbott** has been named southwestern exploration regional land man in Midland, Tex. Abbott had been staff land man for Lion in Houston. **Melvin H. Vaughn** has joined the company as senior geologist in Midland.

James R. Arrington has been named coordinator of corporate analysis in Humble's headquarters economics and planning department, Houston. **J. P. Hamilton** has been named coordinator of investment analysis. **W. M. McCardell** has been named coordinator of long-range planning and **Crandall D. Jones** has been named coordinator of resource economics. Appointment of **Dr. C. S. Overmiller** as coordinator of economics was announced earlier.

Bill Garms, formerly with Garvey Drilling Co., has joined Exeter Drilling Co. as Denver representative.

M. D. Korkut has joined the design staff of Ocean Drilling & Exploration Co., New Orleans, as naval architect.

RIDDLE

Edd Riddle, Jr., Midland, Tex., division exploration manager for Texas Pacitic Coal & Oil Co., has been promoted to exploration coordinator in the company's Fort Worth headquarters office. **William Parsons,** Midland division geologist, will succeed Riddle. Riddle had held the Midland post since 1956.

Donovan P. Dugan, former president of Tuscarora Pipe Line Co. and **Edwin L. Ochs,** former Tuscarora secretary-treasurer, have retired from the Standard Oil Co. (N. J.) organization. Tuscarora, a Jersey affiliate for many years, was recently purchased by Buckeye Pipe Line Co. Dugan was with Tuscarora 30 years. He served as superintendent and vice president before being elected president in 1959. Ochs joined Tuscarora in 1930 and became secretary-treasurer and a member of the board of managers in 1954.

MISSISSIPPI GEOLOGICAL SOCIETY has elected X. M. Frascogna, consulting geologist, third from left, as president for 1961-62. Serving with him will be, left to right, A. T. Ricci, Jr., Mobil Oil Co., secretary; L. J. Ringenberg, Lion Oil division of Monsanto Chemical Co., vice president; Frascogna; and L. B. Culligan, California Co., treasurer.

Walter Gillen, pipe testing and research engineer for Northern Natural Gas Co., has been promoted to general-projects engineer in Omaha. **Henry Graalfs,** pipe testing and research engineer, has been named gas-projects engineer, Omaha, and **Russell Pargett,** pipe testing and research engineer, has been named performance - evaluation engineer. **Arthur Kracke,** survey chief in Skellytown, Tex., has been transferred to Omaha as coordinator of gathering-system construction. **Alan Osborne,** gas technician in Omaha, has been named proration engineer there.

Richard M. Niedbala, field engineer in New York State Natural Gas Corp.'s Sabinsville, Pa., district, has been named corrosion engineer. He will headquarter in the Mamont district office, Murrysville, Pa.

R. Alton Atkinson, Morgan Guaranty Trust Co. of New York, has been elected a director of Alaska Pipe Line Co.

Vernon M. Turner has been promoted to associate general attorney for Tennessee Gas Transmission Co. His primary responsibility will be to advise Tenneco Oil Co., particularly in exploration and production problems.

Joe L. Johnson has purchased a partnership interest in Stephens Engineering, Wichita Falls, Tex., petroleum engineering firm. **Fred Stephens** is senior partner. Johnson has been with Stephens since 1956. He was with Phillips Petroleum before that time.

Harold F. Patterson, district exploration superintendent in Lafayette, La., for Pan American Petroleum Corp., has been appointed North Texas-New Mexico division geophysicist. He will headquarter in Fort Worth. Patterson succeeds **Clarence J. Long,** who has been named Canadian division geophysicist in Calgary.

O. A. Easton, group leader in plant engineering at Dow Chemical's Freeport, Tex., plant, has been promoted to section manager. **R. F. Huston,** group leader, has been production superintendent in benzene recovery. **R. E. Herron,** planning engineer in development, has been named development department director. **R. E. Young,** senior production engineer, has been named assistant production superintendent, brine production.

George T. Piercy, head of coordination and petroleum economics for Standard Oil Co. (N. J.) in New York, has been named executive assistant to **M. J. Rathbone,** Jersey president. Piercy succeeds **C. H. Carpenter,** who will become a director of Esso Mediterranean. **J. S. Baldwin,** assistant manager of coordination and petroleum economics, will succeed Piercy as manager of the department. The appointments are effective July 1. Piercy and Baldwin have held their present posts with coordination and petroleum economics for the past year. Carpenter has been executive assistant since 1957.

Jack Bird, planning and economics adviser in the New York transportation coordination department of Standard Oil Co. (N. J.), has been named assistant Eastern Hemisphere representative for the department. He will headquarter in London.

Ben T. Windham, Charlotte, N. C., sales division manager for Cities Service Oil Co., has been transferred to Atlanta as head of the company's new division office there. The division will handle distribution and sales in Georgia, Alabama, Tennessee, and the Carolinas.

Byron E. Milner, manager of Atlantic Refining Co.'s Atreco refinery, Port Arthur, Tex., has been transferred to Philadelphia as manager of the headquarters refinery-supply department. **A. W. Kusch,** general superintendent of the Port Arthur refinery, will move up to manager there. The appointments are effective July 1.

MILNER

KUSCH

Dr. F. M. Kannenstine has been named director of development and production for Independent Exploration Co.'s geograph program. Kannenstine comes out of retirement to take the post. He headed Kannenstine Laboratories, independent exploration affiliate working with design and building of geophysical equipment, before retiring in 1953 because of ill health. Kannenstine is a former president of Society of Exploration Geophysicists.

▶▶▶ Personals

C. A. Bumpus, process area superintendent at the Bronte, Ont., refinery of Cities Service Refining (Canada), has been named assistant to the superintendent of operations, a new position. **C. E. Chiasson,** general facilities area superintendent, has been named chief refinery engineer, also a new position. **K. G. Seabright,** technical director, has been appointed production superintendent, and **S. B. Stewart,** chief mechanical engineer, has been named production engineer. Also, **W. W. Wilson,** senior process engineer, has been named chief process engineer. **O. J. Spork,** day supervisor, has been named production foreman. **K. C. Stevens,** unit supervisor, has been named night superintendent, and **H. J. Galka,** technical assistant, becomes chief chemist.

Pan American Petroleum Corp. has merged its Lafayette, La., exploration and production district into the New Orleans district. **K. D. Soule** will continue as New Orleans district exploration superintendent under the new set up. **R. M. Darling,** district production superintendent in Lafayette, will hold the same post in New Orleans.

▶▶▶ Deaths

Carl F. Vander Clute, 60, general manager of Gulf Oil Corp.'s marine department, died June 1 at his home in Manhasset, N. Y., after a long illness. Vander Clute had been associated with the marine industry since 1919 and for many years took a leading part in management negotiations with maritime unions. In 1953 he was honored by the tanker industry for his work. Vander Clute joined Gulf in 1939 as assistant to the general manager of the marine department. He became general manager in 1955.

John S. Cordell, 72, retired vice president and general manager of Cities Service Oil Co. (Pa.), died May 21 in a Clearwater, Fla., hospital after a long illness. Cordell joined the Cities Service companies in 1916. He was vice president and general manager of Cities Service Refining Co. before taking the similar post with Cities Service Oil (Pa.) in 1937. He retired in 1946.

Ernest P. Eslick, 75, retired Evansville, Ind., independent operator, died May 31 in an Evansville hospital after a long illness.

Joseph A. Boucherie, 74, retired Phillips Petroleum Co. engineer, died May 28 in Oklahoma City.

Ralph P. Kistler, 74, Tulsa oil man, died June 2 in a Tulsa hospital. Kistler was founder of Consolidated Pipe Line Co. and served as president of the firm until its sale to Pierce-Pennant Oil & Refining Co.

Clifford W. Ritts, 56, a supervisor of gasoline and blending operations at the Oil City, Pa., refinery of South Penn Oil Co.'s Pennzoil division, died June 2 in an Oil City hospital after a brief illness. He had been with South Penn 32 years.

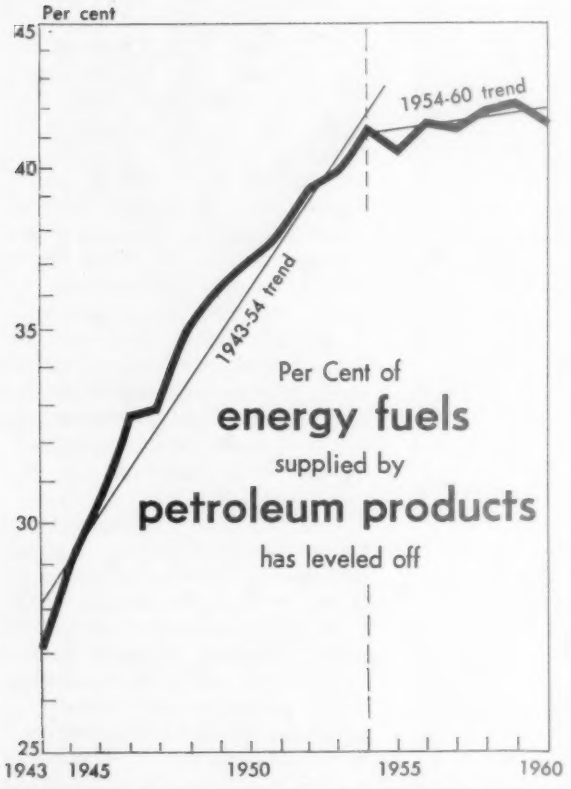
Aaron M. Abrams, 80, Bradford, Pa., drilling contractor, died May 22 at his home in Bradford.

Edwin Pyle, 59, president of Consumer Oil Co., Los Angeles marketing firm, died June 1 in a Los Angeles hospital after several weeks' illness.

Glenn V. Mulcahy, 34, geologist for DeGolyer & MacNaughton, died June 4 in Dallas after a long illness. Mulcahy had been with Atlantic Refining Co. and Sohio Petroleum Co. before joining DeGolyer & MacNaughton.

Earl M. Wilkerson, 57, division warehouse supervisor for Sinclair Oil & Gas Co. in Denver, died May 29 after a short illness.

C. C. Wilson, 76, retired waxplant superintendent at the old Mid-Continent Petroleum Corp.'s Tulsa refinery, died June 7 in a Tulsa hospital. Wilson retired in 1954 after 38 years with Mid-Continent.



LINES show the changes that have taken place in oil's contribution to total energy fuels in this country. The big shift came about 1954.

Oil demand is gaining at total-energy rate

BY JOHN C. CASPER

DEMAND for petroleum products is increasing at about the same rate as that for total energy fuels. In fact, oil's contribution for the year 1960 represented a slightly smaller percentage of the total than for 1959. For 1960 at least, the rate of gain for petroleum products was a little less than the percentage increase for all energy fuels.

Lines on the chart show these changes. Points on the irregular lines represent per cent of total energy fuels that was supplied by petroleum products, starting with 1953 and ending with 1960. The straight lines represent calculated trends for the period 1943-54 and for the shorter period 1954-60.

Lines are plotted on semi-logarithmic scales to show that the changes have been at a constant percentage rate.

Back in 1943, this country was in the middle of an all-out war. Demand for war materials were added to the rationed demand for consumer goods. The industrial production index climbed from 66.2 for the year 1940 to 125.0 for 1943. This production gain called for big increases in demand for all energy fuels. Demand for oil increased but the gain was limited by ability to produce, transport, and refine crude. As a result, oil's contribution to total energy consumption dropped from 32.5% in 1938 to 27.1% in 1943. That was the low point.

Oil's Postwar Climb

Starting with the year 1944, oil steadily regained its prewar position in the energy field and continued to climb. These gains show up as a sharp rise for the line in the 1943-54 period. Oil accounted for 27.1% of total energy fuels in 1943 and increased to 41.5% of the total by 1954. This climb represents 14.4 percentage points in 11 years or 1.3 points a year.

The year 1944 seems to be the leveling-off point. Oil has done no better than hold its own in the energy picture since that time. In fact, oil's position in the energy market for the year 1960 was the same as it was in 1954. The ratio did move up to 42.3% of the total in 1959, but the Bureau of Mines estimate for 1960 shows oil's contribution to the total energy picture back to 41.5%.

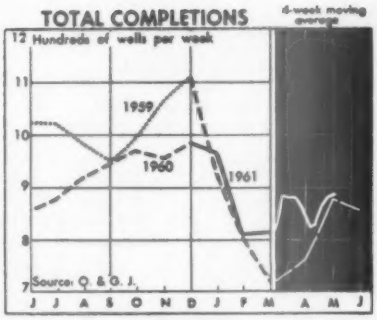
Since oil's percentage includes imports, and since imports have increased at a faster rate than total oil use, demand for domestic crude has lagged the over-all energy parade.

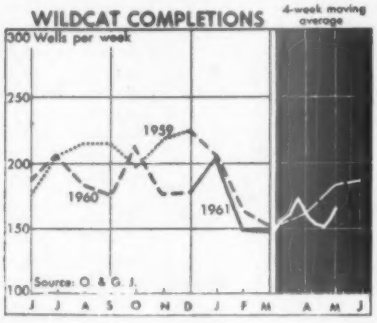
Coal lost position during the 1954-60 period. Even water power dropped from 4.1% of the total in 1954 to 3.9% in 1960. This elimination leaves only gas and gas liquids. We shall chart the records of these fuels next week.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,055,850	DOWN	18,875	UP	111,651
Crude stocks	257,263,000	DOWN	1,080,000	DOWN	2,392,000
Completions	826	DOWN	73	DOWN	72
Refinery runs	8,360,000	UP	311,000	UP	399,000
Gasoline stocks	210,475,000	DOWN	18,000	UP	567,000
Kerosine stocks	27,798,000	UP	644,000	UP	2,781,000
Distillate stocks	95,235,000	UP	4,976,000	DOWN	1,432,000
Residual stocks	44,779,000	UP	740,000	UP	5,046,000
Four-product stocks	378,287,000	UP	6,342,000	UP	6,962,000
Total imports	1,804,400	UP	95,000	UP	167,000

Active Rotary Rigs





	6-5-61	5-29-61	6-6-60
Alabama	5	5	3
Alaska	10	10	4
Arkansas	11	8	14
Arizona	2	2	1
California	70	74	84
Land	64	69	79
Offshore	6	5	5
Colorado	26	31	32
Florida	0	0	2
Land	0	0	2
Offshore	0	0	0
Georgia	2	2	0
Illinois	53	36	42
Indiana	8	5	7
Iowa	1	0	0
Kansas	111	94	121
Kentucky	3	2	5
Louisiana	294	288	291
North	32	26	41
S. Inland waters	114	111	117
S. Land	86	88	79
Offshore	62	63	54
Michigan	29	27	40
Mississippi	63	54	59
Missouri	2	1	3
Montana	23	23	22
Nebraska	41	30	25
New Mexico	117	119	127
North Dakota	19	17	18

	6-5-61	5-29-61	6-6-60
Ohio	7	8	6
Oklahoma	209	198	187
Oregon	0	0	1
Pennsylvania	7	7	14
South Dakota	1	1	1
Texas	632	641	638
S. Inland waters	7	7	6
S. Land	165	167	182
Offshore	3	2	2
North	68	64	48
Panhandle	52	56	48
East	76	91	60
West Central	161	150	176
West	100	104	116
Utah	22	25	31
Virginia	1	0	0
Washington	1	1	0
West Virginia	7	8	4
Wyoming	46	42	65
Total U. S.	**1,823**	1,759	1,847
Cum. avg. to date	1,631	1,622	1,735
Western Canada	143	113	133
Eastern Canada	1	0	2
Grand total	1,967	1,872	1,982

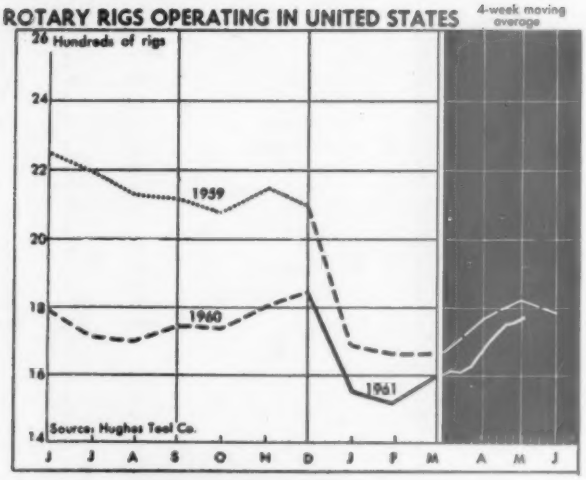
Hughes Tool Co. report.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED JUNE 3, 1961

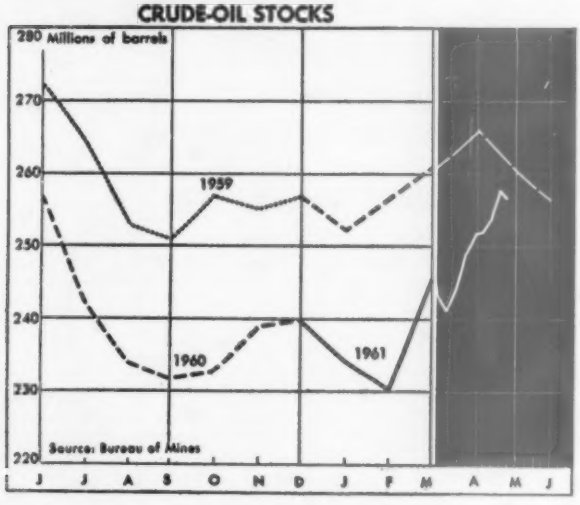
	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1961	1960	Total	Crude	Cond.	Gas	Dry	1961	1960
Alabama	1	1	0	0	0	0	11,676	28	22	0	0	0	0	0	6	1
Alaska	0	0	0	0	0	0	0	16	.....	0	0	0	0	0	2	.....
Appalachian*	50	18	0	15	6	11	93,076	887	712	0	0	0	0	0	26	18
Arizona	1	0	0	0	1	0	1,218	11	7	0	0	0	0	0	7	7
Arkansas	11	4	0	1	6	0	38,354	228	259	3	0	0	0	3	44	65
California	29	16	0	0	11	2	164,474	719	569	6	0	0	0	6	118	126
Colorado	10	2	0	2	6	0	55,180	276	273	3	0	0	1	2	130	130
Illinois	23	6	0	0	16	1	65,312	712	831	6	0	0	0	6	148	197
Indiana	9	4	0	0	4	1	10,123	250	391	1	0	0	0	1	72	154
Kansas	97	48	0	12	34	3	281,948	2,287	1,379	22	2	0	2	18	418	459
Kentucky	16	2	0	2	12	0	28,576	610	685	4	0	0	0	4	67	81
Louisiana	78	31	9	10	28	0	514,577	1,537	1,422	17	0	1	1	15	243	209
North	40	16	1	10	13	0	121,115	543	464	9	0	0	1	8	97	88
South	24	14	1	0	9	0	229,949	760	723	4	0	0	0	4	125	106
Offshore	14	1	7	0	6	0	163,513	234	235	4	0	1	0	3	21	15
Michigan	15	3	0	2	7	3	43,150	287	309	3	0	0	0	3	112	94
Mississippi	10	5	0	0	5	0	91,892	232	314	4	0	0	0	4	75	105
Montana	5	3	0	0	2	0	33,035	155	108	2	0	0	0	2	71	49
Nebraska	22	6	0	0	16	0	90,847	403	341	10	1	0	0	9	171	128
New Mexico	10	3	0	3	4	0	41,010	740	769	3	2	0	0	1	131	111
West	10	3	0	3	4	0	41,010	323	248	3	2	0	0	1	45	22
East	0	0	0	0	0	0	0	417	521	0	0	0	0	0	86	89
North Dakota	7	3	0	0	4	0	43,920	106	130	1	0	0	0	1	28	29
Ohio	13	5	0	4	2	2	34,625	422	439	0	0	0	0	0	20	24
Oklahoma	38	15	1	6	16	0	116,777	2,462	1,653	1	0	0	0	1	248	316
Texas	356	179	10	26	137	4	1,314,310	6,086	6,854	81	3	2	3	73	1,228	1,377
Dist. 1	28	1	0	0	27	0	48,696	375	467	25	0	0	0	25	145	164
Dist. 2	13	2	3	1	7	0	84,385	292	326	4	0	2	0	2	64	76
Dist. 3	24	10	2	1	11	0	184,649	452	530	5	0	0	0	5	91	98
Dist. 4	51	36	1	7	7	0	154,397	536	485	3	0	0	0	3	113	139
East	36	23	2	1	9	1	150,707	496	521	7	0	0	1	6	111	111
Dist. 7-B	50	24	1	2	23	0	114,138	860	995	8	1	0	2	5	227	241
West	85	52	0	1	31	1	356,034	1,513	1,820	25	2	0	0	23	329	292
Dist. 9	48	26	1	0	19	2	111,805	1,017	1,286	3	0	0	0	3	106	188
Dist. 10	21	5	0	13	3	0	109,499	545	424	1	0	0	0	1	42	28
Utah	2	0	0	0	2	0	16,280	109	124	1	0	0	0	1	45	44
Wyoming	13	4	0	2	7	0	70,035	421	414	8	1	0	0	7	159	178
Misc. (Tenn.)	10	0	0	2	8	0	5,721	97	56	10	0	0	2	8	91	45
Total U. S.	**826**	358	20	87	334	27	3,166,116	19,081	18,061	**186**	9	3	9	165	3,660	3,947
Previous week	899	428	16	82	338	35	3,352,815	.....	.....	157	13	0	1	143	.....	.....
Cum. 1961	19,081	8,684	419	1,864	6,861	1,253	76,906,451	.....	.....	3,660	283	46	172	3,159	.....	.....
Cum. 1960	18,061	8,524	574	1,465	6,978	520	79,178,545	.....	.....	3,947	364	45	134	3,404	.....	.....
Western Canada	23	13	0	2	8	0	131,622	896	915	7	0	0	1	6	268	268

PRODUCTION

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	5-27-61	5-20-61	5-28-60
Pennsylvania	2,375	2,319	2,145
Other Appalachian	1,574	1,501	1,827
Illinois, Indiana, Michigan	10,033	10,036	9,946
Nebraska and North Dakota	3,102	3,268	2,791
Kansas	9,930	9,701	9,817
Oklahoma	17,467	17,230	17,583
Arkansas	2,028	2,152	1,967
Louisiana	21,264	21,377	19,920
North	3,437	3,421	3,471
South	17,827	17,956	16,449
Mississippi, Alabama, Florida	1,851	1,889	2,050
New Mexico	7,992	8,239	7,799
Texas	109,245	109,790	110,211
East Texas	9,268	8,903	8,967
West Texas	48,572	49,665	49,717
Texas Gulf	19,381	19,244	19,344
Other Texas	32,024	31,978	32,183
Wyoming	19,547	19,196	17,718
Other Rocky Mountain	9,287	9,410	10,382
California	25,283	25,020	29,016
Foreign	†16,285	17,215	16,483
Total	257,263	258,343	259,655

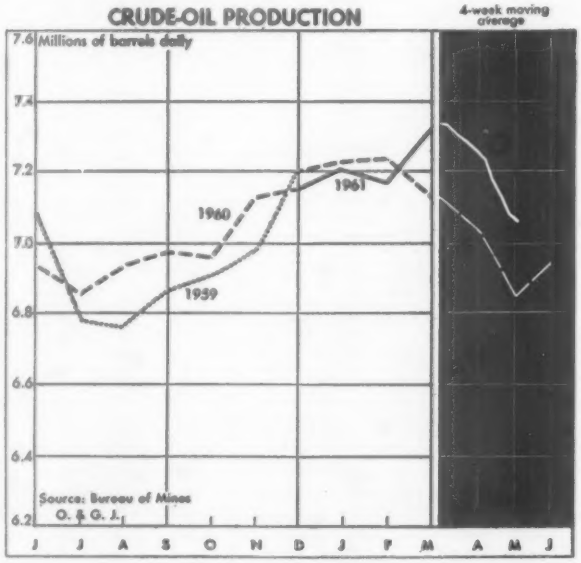
*Bureau of Mines. †Includes 4,733,000 bbl. in California.

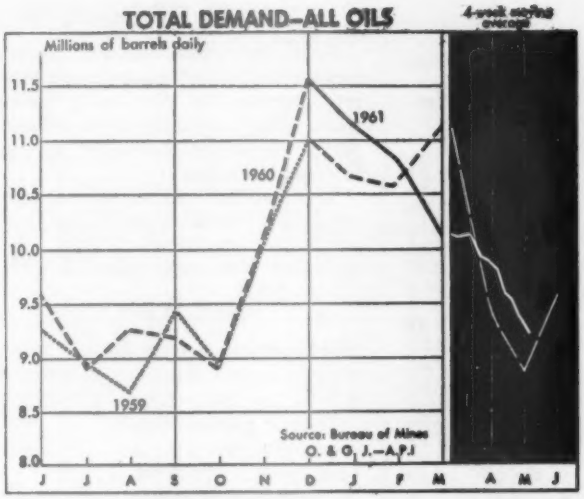
DAILY AVERAGE PRODUCTION FOR WEEK

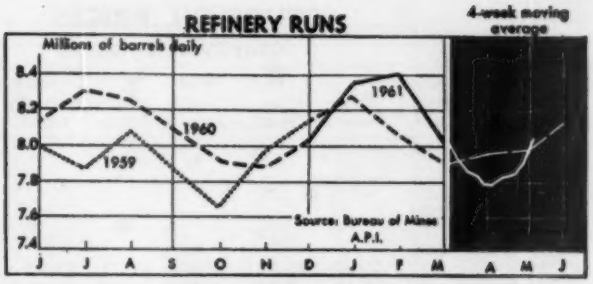
	June 3, 1961 Crude oil	Lease condensate	Total	May 27 total
Alabama	19,200	.....	19,200	19,350
Alaska	14,000	.....	14,000	13,500
Arkansas	80,800	125	80,925	81,000
California	823,500	.....	823,500	826,500
Colorado	128,500	.....	128,500	130,800
Eastern	40,100	.....	40,100	41,000
Florida	1,075	.....	1,075	1,100
Illinois	216,400	.....	216,400	211,300
Indiana	30,300	.....	30,300	29,900
Kansas	†311,325	.....	†311,325	†316,550
Kentucky	49,100	.....	49,100	49,100
Louisiana	1,021,675	133,725	1,155,400	1,162,800
North	104,950	5,225	110,175	110,300
South	916,725	128,500	1,045,225	1,052,500
Michigan	52,100	.....	52,100	51,900
Mississippi	146,050	3,700	149,750	150,200
Montana	81,000	.....	81,000	82,400
Nebraska	66,200	.....	66,200	66,800
Nevada	450	.....	450	450
New Mexico	309,425	6,800	316,225	317,300
North Dakota	52,300	.....	52,300	55,100
Oklahoma	†516,100	.....	†516,100	†529,500
Texas	2,370,700	89,600	2,460,300	2,448,350
District 1	43,000	2,300	45,300	45,400
District 2	97,575	8,100	105,675	105,400
District 3	301,150	37,000	338,150	337,000
District 4	169,275	12,500	181,775	180,800
District 5	26,000	500	26,500	26,600
District 6	104,575	8,200	112,775	112,400
East Texas field	125,150	.....	125,150	124,000
District 7-B	120,275	250	120,525	120,400
District 7-C	108,925	3,150	112,075	111,650
District 8	982,725	12,000	994,725	988,000
District 9	190,850	3,400	194,250	193,800
District 10	101,200	2,200	103,400	102,900
Utah	97,600	.....	97,600	95,400
Wyoming	393,300	.....	393,300	393,800
Others	‡700	.....	‡700	‡625
Total U. S.	6,821,900	233,950	7,055,850	7,074,725
Change from prev. week, down			18,875	.....
Canada	†611,100	.....	†611,100	†638,800
Total U. S. prod.—Jan. 1-June 3				1,117,375,900 bbl.
Same period last year (crude plus cond.)				*1,099,363,600 bbl.

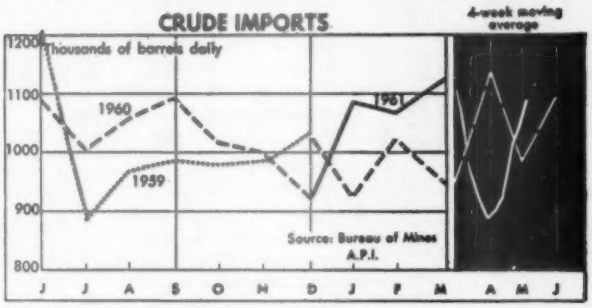
*Includes 36,028,700 bbl. condensate. †Week ended previous Monday. ‡South Dakota and Arizona.

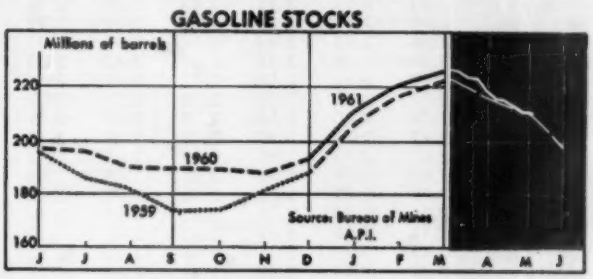
CRUDE-OIL PRODUCTION

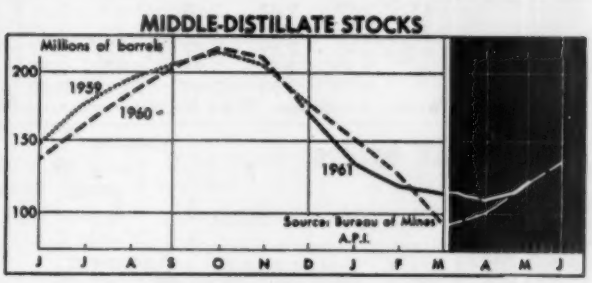


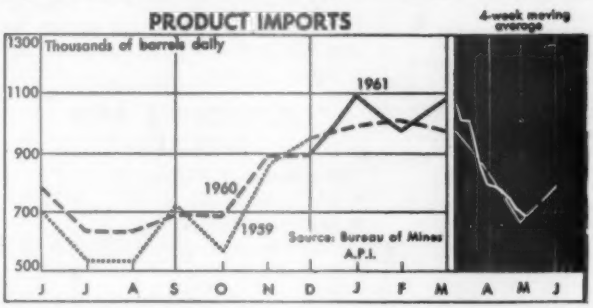


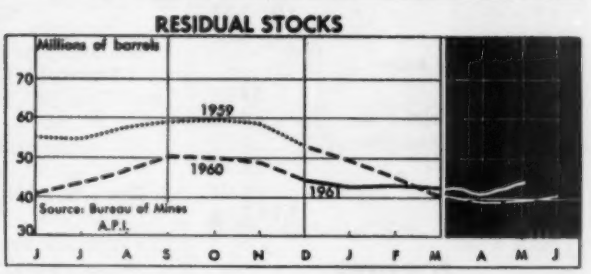












API REFINERY REPORT, JUNE 2, 1961

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, June 1960—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,105	511.7	34.6	311.4	139.4	49,310	10,413	28,049	11,210	1,128	528.9	34.2	325.7	146.4
Appalachian:														
District 1	104	42.7	3.1	24.1	11.4	5,961	629	2,119	407	96	41.2	2.7	21.7	7.7
District 2	99	52.6	3.0	21.4	10.0	3,270	381	1,120	337	90	46.6	2.1	16.3	8.5
Ind., Ill., Ky.	1,526	742.6	57.7	306.3	129.0	37,555	4,706	16,197	5,025	1,455	774.4	66.7	301.8	128.0
Minn., Wis., Dak.	131	62.8	4.9	32.9	19.4	6,575	661	3,761	670	128	62.3	5.3	32.8	14.6
Okla., Kans., Mo.	726	392.3	10.1	143.3	12.4	18,455	1,359	9,401	1,011	751	422.7	17.5	175.7	21.0
Inland Texas	317	200.6	12.0	62.6	20.7	7,792	542	1,554	2,659	304	223.5	10.0	49.8	22.4
Texas Gulf Coast	1,919	1,024.7	98.5	449.4	142.6	29,462	3,463	11,021	4,939	1,967	1,007.0	95.5	462.6	141.8
La. Gulf Coast	657	403.7	28.7	147.4	82.6	11,045	2,899	4,461	1,286	653	329.2	45.0	136.5	41.6
N. La. and Ark.	115	58.6	5.6	23.1	7.3	5,989	696	2,483	141	112	64.5	4.9	24.4	5.6
Rocky Mountain:														
New Mexico	25	11.8	0.7	4.7	2.1	772	46	218	36	24	13.2	0.3	4.3	2.2
Other Rocky Mt.	294	146.6	14.6	64.7	34.4	7,705	469	2,457	922	275	132.9	3.7	63.2	27.8
West Coast	1,342	500.7	40.4	190.7	320.7	26,584	1,534	12,394	16,136	1,143	513.7	37.4	163.2	275.7
June 2, 1961	8,360	4,151.4	313.9	1,782.0	932.0	210,475	27,798	95,235	44,779	8,126	4,160.1	325.3	1,778.0	843.3
May 26, 1961	8,049	4,155.6	248.7	1,850.3	846.0	210,493	27,154	90,259	44,039	.....	.....	.....	.....	.....
June 3, 1960	7,961	4,134.7	325.1	1,749.3	889.9	209,908	25,017	96,667	39,733	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Oklahoma	West Tex. (sour)	West Tex. (Inter.)	No.* Texas	Texas Refugio Light	Bayou Sale (La.)	Denver Julesburg	Wyo. (sour)
14-14.9	$1.86	....	....	....	....	....	....	....	....
15-15.9	1.93	....	....	....	....	....	....	....	$1.81
16-16.9	2.00	....	....	....	....	....	....	....	1.86
17-17.9	2.06	....	....	....	....	....	....	....	1.91
18-18.9	2.13	....	....	....	....	....	....	....	1.96
19-19.9	2.20	....	(†)	....	....	....	....	....	2.01
20-20.9	2.27	$2.49	$2.35	$2.61	$2.29	$2.95	$2.90	$2.58	2.06
21-21.9	2.33	2.52	2.38	2.63	2.33	2.97	2.92	2.60	2.11
22-22.9	2.40	2.55	2.41	2.65	2.37	2.99	2.94	2.62	2.16
23-23.9	2.46	2.58	2.44	2.67	2.41	3.01	2.96	2.64	2.21
24-24.9	2.53	2.61	2.47	2.69	2.45	3.03	2.98	2.66	2.26
25-25.9	2.60	2.64	2.50	2.71	2.49	3.05	3.00	2.68	2.31
26-26.9	2.67	2.67	2.53	2.73	2.53	3.07	3.02	2.70	2.36
27-27.9	2.74	2.70	2.56	2.75	2.57	3.09	3.04	2.72	2.49
28-28.9	2.81	2.73	2.59	2.77	2.61	3.11	3.06	2.74	2.54
29-29.9	2.87	2.76	2.62	2.79	2.65	3.13	3.08	2.76	2.59
30-30.9	2.93	2.79	2.65	2.81	2.69	3.15	3.10	2.78	2.63
31-31.9	3.00	2.82	2.68	2.83	2.73	3.17	3.12	2.80	2.67
32-32.9	3.06	2.85	2.71	2.85	2.77	3.19	3.14	2.82	2.71
33-33.9	3.12	2.88	2.74	2.87	2.81	3.21	3.16	2.84	2.75
34-34.9	3.17	2.91	2.77	2.89	2.85	3.23	3.18	2.86	2.79
35-35.9	3.22	2.94	2.80	2.91	2.89	3.25	3.20	2.88	2.83
36-36.9	3.27	2.97	2.83	2.93	2.93	3.27	3.22	2.90	2.87
37-37.9	3.31	2.99	2.86	2.95	2.95	3.29	3.24	2.92	2.89
38-38.9	....	3.01	2.89	2.97	2.97	3.31	3.26	2.94	2.91
39-39.9	....	3.03	2.92	2.99	2.99	3.33	3.28	2.96	2.93
40-44.9	....	3.05	2.95	3.01	3.01	3.35	3.30	2.98	2.95

*Cooke, Grayson, Montague. †Two buyers announced increase.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.23-3.53
Van	3.08
Pennsylvania Grade:	
Bradford	$4.80
Middle District	4.52
Southwest Pennsylvania	4.25
West Virginia	4.17
Buckeye Grade	4.08
Illinois Basin	**3.00-3.05**

FOREIGN

Middle East, Persian Gulf: (cargoes f.o.b. lifting port)	
Arabian, 34.0°-34.9°, Ras Tanura	$1.80
Iranian, 34.0°-34.9°, Bandar Mashur	1.78
Iranian, 34.0°-34.9°, Abadan	1.73
Iraq, 35.0°-35.9°, Fao	1.72
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.59
Qatar, 41.0°-41.9°, Umm said	1.95
Middle East, E. Mediterranean:	
Arabian, 34.0°-34.9°, Sidon	$2.17
Iraq, Mosul-Kirkuk, 35.0°-35.9°, Tripoli	2.19
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 36°	2.42
Canada:	
Leduc-Woodbend	$2.53
Redwater (Alta.)	2.42
Weyburn (light)	2.06
Midale C	1.70
Venezuela:	
Cumarebo, 47°-47.9°, Tucupido	3.34
San Joaquin, 40°-40.9°, Puerto La Cruz	3.08
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0°-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

TANKER RATES (Long Ton)

(Latest reported spot fixtures)

★ Gulf-NY, dirty (ATRS—17.5%)	$2.35
Carib.-NY, dirty (ATRS—60%)	1.10
★ Carib.-UK, dirty (Scale—65%) (11s. 5d.)	1.60
★ PG-Japan, dirty (USMC—72.5%)	2.81
★ PG-NY, dirty (USMC—75%)	3.18

★Denotes change from previous week.

REFINED PRODUCTS

Following quotations are realistic spot prices for refined products moving interstate on Wednesday each week. They may differ from refiners' posted prices and should not be considered as postings.

Light-product prices are in cents per gallon. Residual and crude prices are dollars per barrel. Crude prices are at the well unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
★ Regular (91 octane)	12.25-12.50
★ Premium (99 octane)	15.00-15.25
Natural gasoline (26-70)	4.5
Breckenridge	4.0
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.50-11.00
Regular (92 octane)	10.75-11.25
Premium (98 octane)	11.75-12.25
California (rack) Los Angeles:	
Regular (90 octane)	11.60
Premium (94 octane)	12.60
Premium (100 octane)	14.10
Caribbean area (cargoes):	
Regular (87 octane)	9.125
Premium (97 octane)	11.50

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
★ Kerosine 42-44	9.50-9.75
★ Diesel oil (58 d.i. and above)	9.00-9.25
★ Distillate No. 1	9.00-9.25
Distillate No. 2	8.25-8.50
Gulf Coast (cargoes):	
★ Kerosine 41-43	9.00
★ Distillate No. 2	8.25
New York Harbor (barges):	
Kerosine 42-43	*11.40
Distillate No. 2	*10.40
Diesel fuel, 48-52 d.i.	*10.55
Caribbean area (cargoes):	
Distillate No. 2	8.625

*Subject to 0.5 cent discount.

RESIDUAL FUEL (Bbl.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.65-1.75
Gulf Coast (cargoes):	
★ Bunker C fuel	2.20
New York Harbor (barges):	
Bunker C fuel	2.52
Caribbean (cargoes):	
Bunker C fuel	2.00
California (rack):	
Bunker C fuel, Los Angeles	2.25

SUPPLY AND DEMAND—PRODUCTS
(Thousands of barrels daily)

GASOLINE

	Total demand	Refinery production	Stocks end of period†
May 1961*	4,450	4,090	210,500
April 1961*	4,320	3,940	219,300
March 1961	4,101	4,067	223,660
June 1960	4,674	4,160	198,452
May 1960	4,238	3,989	210,509

KEROSINE

May 1961*	255	285	27,200
April 1961*	360	355	26,200
March 1961	377	409	25,666
June 1960	223	325	27,354
May 1960	202	318	24,217

DISTILLATE

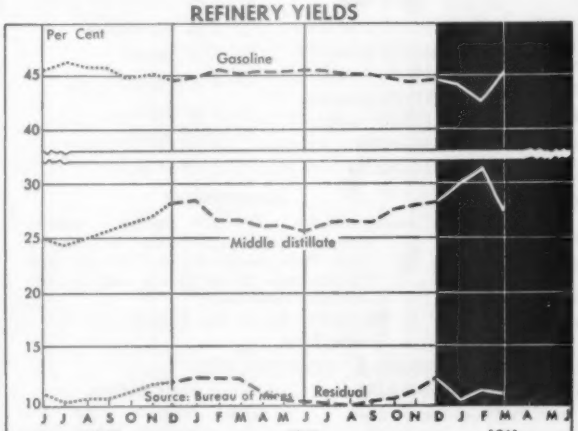
May 1961*	1,425	1,725	94,500
April 1961*	1,840	1,615	84,000
March 1961	2,155	1,805	87,950
June 1960	1,363	1,778	109,174
May 1960	1,343	1,737	95,461

RESIDUAL

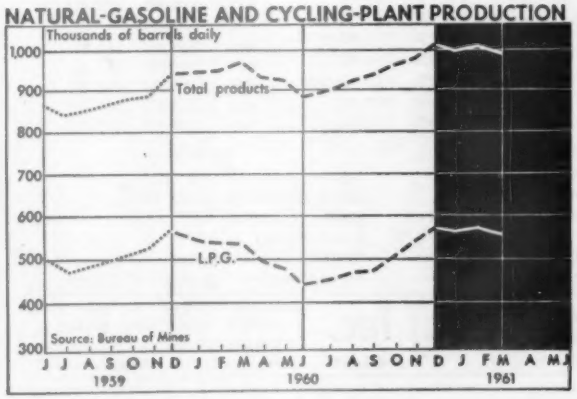
May 1961*	1,365	855	44,700
April 1961*	1,570	840	41,300
March 1961	1,685	883	40,889
June 1960	1,377	843	41,074
May 1960	1,346	841	39,628

*Preliminary. †Thousands of barrels.

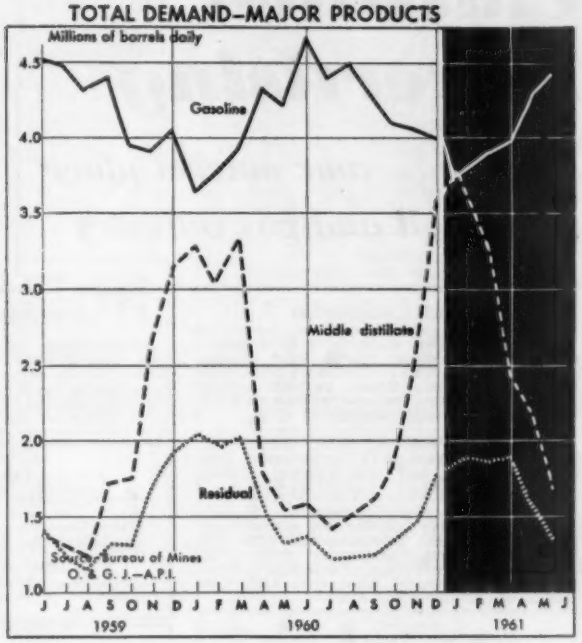
REFINERY YIELDS



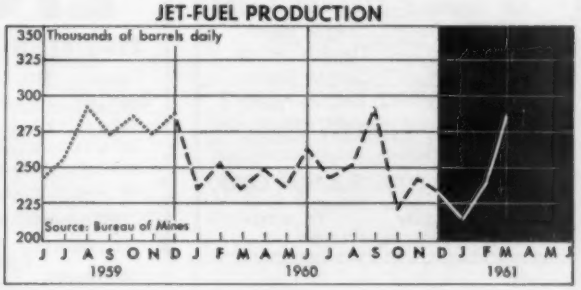
NATURAL-GASOLINE AND CYCLING-PLANT PRODUCTION



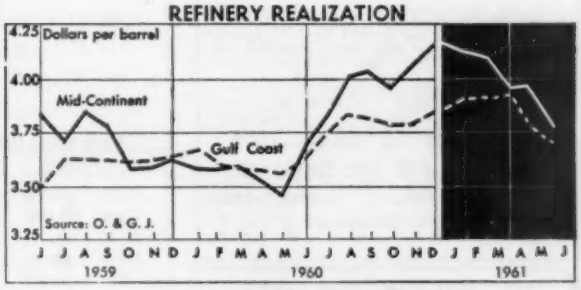
TOTAL DEMAND–MAJOR PRODUCTS



JET-FUEL PRODUCTION



REFINERY REALIZATION



REFINERY REALIZATION

	May*	Apr.*	Mar.	Feb.
Mid-Continent	$3.77	$3.97	$3.94	$4.04
Gulf Coast	3.71	3.78	3.94	3.96

*Preliminary. Refinery realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel and residual as published in The Oil and Gas Journal.

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MISC. DRILLING equipment, Unit drawworks, Lee C. Moore masts, light plants, standby pumps, drill collars, drill pipe, line pipe, water tanks, tongs, swivels, rotary tables, tool houses, for rent or sale. 906-914 S.E. 29th, OR 7-4541, Oklahoma City.

WILL SACRIFICE! All offers considered. 800 HP Worthington, LT6 Compressor. Box M-381, The Oil and Gas Journal, Tulsa, Oklahoma.

CLARK MA-4 Gas Compressor, 150 HP, skid-mounted with radiator and accessories; 2 I.R. XVG6 Gas Compressors; 4225 HP Clark Centrifugal Compressor 9920 CFM 240 PSI discharge Pumps; Exchangers; Vessels. Brill Equipment Company, 4101 San Jacinto St., Houston 4, Texas.

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IMMEDIATE DELIVERY

12" Lapweld—375 Wall—49.56#
140,000 ft.—#1 Single joints
275,000 ft.—#1 Double joints
45,000 ft.—#2 Single joints
2,000 ft.—#2 Double joints

This pipe is clean, straight and beveled for welding. Priced to sell. Located in Kansas and Nebraska. Inquiries invited.

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Pipe Sales Division
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NEW LARGE STORAGE TANKS

4—100,000-barrel Cone Roof Tanks 134' dia. x 40' high, fabricated to API Specs, but never erected and used. Suitable oil and other liquid storage. Detailed prints available.

Priced attractively prompt shipment Rome, N. Y., or will erect your location and sell or lease.

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Tulsa, Oklahoma

LOCATED HOUSTON, TEXAS

(from Amoco Refinery Co., Destrehan, La.)

HEAT EXCHANGERS
50 to 4,000 sq. ft.
VESSELS—TOWERS
12" to 8' dia.
PETROCHEM FURNACES
½MM, 2½MM, 5MM BTU
PUMPS
50 to 7,000 GPM

—WIRE—PHONE—WRITE—

BRILL EQUIPMENT COMPANY
4101 SAN JACINTO ST., HOUSTON 4, TEXAS
38-48 JABEZ STREET, NEWARK 5, N. J.

FOR SALE EQUIPMENT

SERVICING, COMPLETION and Workover Unit-Walker-Neer Model C28, double drum, 65 foot structural telescoping derrick, mounted on 6 x 6 truck powered with GMC 671 diesel engine. Factory overhauled. Some tools. Bargain price. Box M-421, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE

2—Beaird Packaged Compressor Units 660 HP
1—Clark Compressor, 800 BHP, Model RA-8
1—Petro Chem Furnace, 1 MM BTU, New
1—U. S. Auto Jet Filter, 200 sq. ft. S/S

SNOW EQUIPMENT CO.
1700 Holcombe Blvd., Houston 25, Texas
JA 2-0359

FOR SALE EQUIPMENT

FOR SALE: National Tank Company LTX Unit, Serial #133, Built 1951 W.P. 1200#, Capacity 5 MMCF, with Foxboro Model 40 Stabilog Temp. Controller, Serial #J52455. FOB location, Hidalgo County, Texas. $2,500.00. Contact: Bob Miner, 207 Sun—Texaco Building, Corpus Christi, Texas.

AT N. LITTLE ROCK, ARKANSAS

3—Worthington #LTC-4 compressors, 3500 CFM @ 45 PSI, 24 x 15, 2-cyl., 500 HP, 4-cycle. gas-engine drive.

Phone POplar 3-3505

PERRY EQUIPMENT CORP.
1402 N. Sixth St.
Philadelphia 22, Pa.

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ESSO REFINERY—BALTIMORE, MD.—MOST EQUIPMENT NEW 1956

TOWERS

84" x 39' 16 Trays 178 PSI
54" x 30' 12 Trays 200 PSI NEW
48" x 39' 16 Trays 283 PSI
36" & 6' x 97' 34 Trays 280 PSI
30" x 36' 9" 7 Trays 360 PSI

PETRO-CHEM FURNACES

30.7MM/BTU 19.3MM/BTU
10.4MM/BTU 9.7MM/BTU
7.5MM/BTU 2MM/BTU

NEW 5% CHROME FURNACE TUBES

1,200'-6" ½" Wall 420'-6" ⅜" Wall
114'-5" " " 250'-5" " "
1,030'-4" " " 1,300'-4" " "

DRUMS

12' x 45' 171 PSI NEW
10' x 30' 160 PSI Lead Lined
9' 4" x 38' 345 PSI Refractory
8' 6" x 35' 120 PSI Gunite
94" x 20' 319 PSI Refractory
6' x 33' 175 PSI Gunite
6' x 27' 300 PSI 18-8 SS Screens
6' x 13' 114 PSI NEW
64" x 25' 323 PSI Refractory
5' x 20' 240 PSI NEW
4' x 17' 530 PSI
4' x 14' 250 PSI Gunite
3' x 16' 286 PSI
3' x 13' 300 PSI Gunite
3' x 12' 5" 550 PSI

COMPRESSORS

3—Ingersoll-Rand 510 CFM Hydrogen Recycle Type 2HHE Non-Lubricated Compressors, Single Stage, Double Acting, 2 Cylinder, 500 PSI Discharge, 350 HP Totally Enclosed Inert Gas Filled Motor Drive.

2—Worthington Recycle Gas Boosters 7¾" x 9", Motor Drive.

HEAT EXCHANGERS & CONDENSERS

18-8 STAINLESS STEEL			ADMIRALTY			5% CHROME		
SqFt	Tubes	Shell	SqFt	Tubes	Shell	SqFt	Tubes	Shell
2,320	75 PSI	135 PSI	1,640	100 PSI	145 PSI	1,040	1,500 PSI	110 PSI NEW
1,860	625 PSI	145 PSI	1,350	100 PSI	530 PSI	975	530 PSI	200 PSI
1,150	75 PSI	15 PSI	1,135	100 PSI	230 PSI	573	530 PSI	715 PSI
1,000	100 PSI	50 PSI	1,025	75 PSI	100 PSI NEW		STEEL	
890	100 PSI	75 PSI	665	100 PSI	236 PSI	2,240	840 PSI	260 PSI
615	100 PSI	75 PSI	600	100 PSI	325 PSI NEW	1,040	840 PSI	145 PSI
420	100 PSI	100 PSI	548	100 PSI	200 PSI	890	230 PSI	165 PSI
235	75 PSI	75 PSI	216	100 PSI	260 PSI	485	715 PSI	260 PSI
						238	570 PSI	530 PSI

RECYCLE GAS DRYER
consisting of
2—4' 6" x 11' Recycle Drums 600 PIS
1—1' 4" x 4' 3" Hydrier 230 PSI

CENTRIFUGAL BLOWER
7,500 CFM, 42.5 PSIG with 1,250 HP
Synchronous motor

PUMPS
Ingersoll-Rand 400 GPM @ 615'
Pacific 349 GPM @ 2,040' 7 Stage
Pacific 173 GPM @ 738'
Byron Jackson 107 GPM @ 1,460' 12 Stage 410 SS Impeller
Byron Jackson 88 GPM @ 1,750' 8 Stage

Heat & Power Co., Inc.
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USED QUICK-CYCLE Hydrocarbon Recovery and gas dehydration units: 12 MM to 27MM SCFD capacities 100# W.P.—turnkey installations. Other used gas processing equipment available including absorption and fractionation towers, vessels, furnaces, etc. Also gas dehydrators, glycol type. Engineered Specialties Co. Box 35683, Phone FL 1-5284, Dallas, Texas.

Sales—GAS COMPRESSORS—Rentals

Save 25% to 40% over new price
Used 30 h.p. to 300 h.p.—Guaranteed
New and Rebuilt Gas Engines

INDEPENDENT FIELD SERVICE, INC.
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Phone 425-3497

1—U-34 Unit Rig Drawworks w/2 GKU-145 Waukesha Engines.
2—87' LCM Mast & Substructure.
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Write for Equipment Inventory

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Radiant with separate convection section, 2.04 MM BTU/HR Heat Absorption Rating, 14,600 LBS/HR Charge Rate, 140° F. temperature differential, 95 PSIG Inlet Pressure, Series 300 ASA Flanges, Natural Gas Burner, ASTM-106B Sched. 40 Carbon Steel Tubes, 6'-0" OD x 10'-6" high to Bottom Stack.

One Vertical Convection Crude Oil Heater

Radiant Integral Two-Pass 5.35 MM BTU/HR Heat Absorption Rating, 135,310/11.181 LBS/HR Charge Rate of 21° API/18 M.W. Crude, 150/220° F. Inlet/Outlet Temperature, 102 PSIG Inlet Pressure, Ohio 1000 Series 850 Cleanout Headers, Natural Gas Burners, ASTM A-161 Carbon Steel Tubes, 7'-3" OD x 23'-0" high to Base of Stack.

NEW—Specially priced for immediate sale.

Address requests for prices or additional information to:

Box M-435, The Oil and Gas Journal
Tulsa, Oklahoma

FOR SALE

Absorption Type Gasoline Plant, located near Haynesville, Claiborne Parish, Louisiana, consisting of the following major items of equipment, together with auxiliary equipment:

1—10'0" x 42'0" Still Reflux Tank, 126# D.P. @ 450° F.
4—96" x 54'0" Horizontal Iso-Butane Storage Tanks, 112# D.P. @ 450° F.
1—42" x 84'0½" Debutanizer
1—36" x 65'0" Depropanizer
1—48" x 48'0" Still
1—42" x 64'0" Fat Oil Stabilizer
1—42" x 63'9" Absorber
1—54" x 117'6" Deisobutanizer
3—12'0" x 48'0" Gasoline Storage Tanks
2—9'0" x 36'0" Propane Storage Tanks, 220# W.P.
1—30' x 42' x 10' Steel Building
3—75 KW General Electric Generators, Model 8236851, 93.8 KVA, 480 V-N-60
5—Henry Vogt Class ML-4-17 Bent Tube Water Tube Boilers

This equipment to be sold in place, as is, for dismantling and removal at expense of buyer. For appointment to inspect, contact.

Otis P. Addington, General Manager
Haynesville Operators Committee
Telephone 300
Haynesville, Louisiana

FOR SALE EQUIPMENT

1 MODEL-D SONOLOG well sounder. Used approximately 10 hours. $2,200.00 F.O.B. Post Office Box 323, Jackson, Miss.

FOR SALE:
Abandoning machine mounted on semi-trailer. Skid Mounted. Can be removed from trailer very easily. Complete with hydraulic jacks and many tools. The Oil Tool Corporation, 3075 Cherry Avenue, Long Beach 7, Calif.

1—TYPE 10 BESSEMER Twin with late type 17" power cylinders, Two stage compressor. 1—Type 10 Bessemer single with late type 17" Power Cylinders, Two stage tandem. Wescott-Greis meters, back pressure regulators and meter setting. All in excellent condition. Thomas Drilling Co., Inc., First National Bank Building, Holdenville, Oklahoma.

LIQUIDATION
at WHITING, IND.

Modern 15,000 BSD Fixed Bed HYDROFORMER

Must Remove At Once Will Be Sold As Units Or Piecemeal

3—Steam Driven GAS COMPRESSORS
2495 CFM 205 PSI Discharge
3—Steam Driven
RECYCLE GAS COMPRESSORS
11840 CFM 325 PSI Discharge
1—Electric Driven AIR COMPRESSOR
2760 CFM 325 PSI Discharge 800 HP

DRUMS
8' x 30' 222 PSI Design
6' x 15' 342 PSI Design
6' x 22' 1260 PSI Design

TOWERS
8' x 63'—18 tray 390 PSI
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4' x 83'—34 tray 222 PSI

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VESSELS

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60 East 42nd St., New York 17, N. Y.
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HELP WANTED

NATURAL GAS Engineer with engineering degree plus 3 to 5 years experince in plant design or operation for work in the Gulf Coast Area. Amerada Petroleum Corp., Gas Department, P. O. Box 2040, Tulsa, Oklahoma.

PETROLEUM ENGINEER: To manage production department and handle drilling program. Must have California experience. Salary commensurate with ability. Bolsa Chica Oil Corporation, 612 South Flower Street, Los Angeles—MAdison 9-2578.

CASINGHEAD GASOLINE plant foreman needed by independent oil company. Please state qualifications, references. Replies confidential. Box M-415, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL JOB DIRECTORY, foreign and domestic, showing where to apply for jobs. $5.00 cash OIML Co., Box 2003, Tulsa, Oklahoma.

HELP WANTED

EXPANDING INDEPENDENT, requires 6-10 years experienced reservoir engineer competent in miscible, water, gas drives, and unit engineering committee work. Box 929, Tyler, Texas.

POSITIONS OPEN for superintendent, chief operator, chief repairman, and chief clerk for new natural gasoline plant under construction at Lignite, North Dakota. Reply to The TXL Oil Corporation, 3100 Fidelity Union Tower, Dallas 1, Texas.

PETROLEUM ENGINEER for sales work. Houston Manufacturer of gas lift and oilfield production equipment. Give resume of experience. Our employees know of this ad. Box M-418, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED:
DEVELOPMENT AND PROJECT CHEMIST
Established West Texas servicing company needs an experienced "take charge" chemist who can roll up his sleeves and go to work initiating, developing and completing his own projects as well as those assigned by management. Previous well-servicing research required. Salary open. Forward comprehensive personal resume to:

Box M-428, The Oil and Gas Journal
Tulsa, Oklahoma

CHEMICAL ENGINEER

Independent Refiner located in Northwest Louisiana has immediate opening for a graduate Chemical Engineer with several years experience in petroleum refining. Applicant should have varied background in both practical and technical aspects of petroleum refining. A practical approach to problems is essential for this position. Submit complete resume of experience, education and salary requirements. Reply to:

Box M-429

The Oil and Gas Journal
Tulsa, Oklahoma

CHIEF PROCESS ENGINEER

Clark Oil & Refining Corp., has opening for Chief Process Engineer. Must have B.S. or M.S. in Chemical Engineering and varied experience in process calculations. General knowledge and understanding of Cat Cracking, Alkylation, Platforming, and utilities desirable. Send complete resume, including salary requirements to:

CLARK OIL & REFINING CORP.
P. O. Box 297
Blue Island, Illinois

PROCESS ENGINEERS

Large chemical processing company invites graduate engineers to join its expanding technical staff.

Qualifications should include B.S. or M.S. degree in Chemical Engineering and 1 to 5 years years experience in process engineering.

Applicants should presently be located in Western States region.

Location of these openings are at our Boron, California plant. Salary open with excellent fringe benefits.

For personal interview send a resume of education and experience to:

Personnel Manager
U. S. BORAX
630 Shatto Pl., Los Angeles 5, Calif.

SITUATIONS WANTED

MECHANICAL ENGINEER 36, B.S., family, 12 years refinery and petrochemical design, maintenance, construction. Presently overseas, available August. Box M-413, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER: 32, 6 years diversified experience (Drilling, workovers, budgets, forecasts, production, reservoir, evaluations) with major in South America. Will relocate anywhere in U. S. Resume on request. Box M-422, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTING SUPERVISOR

Twenty years responsible and diversified experience with independent. Willing to relocate in Montana, Wyoming, Colorado or South Dakota with oil company offering opportunities for advancement. For personal resume write: Box M-434, The Oil and Gas Journal, Tulsa, Oklahoma.

ELECTRICAL ENGINEER: 35, ten years pipeline station electrical and control design, construction, and startup, foreign and domestic. Box M-397, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICIST, B.S. in Geophysical Engineeering, 5 years seismic and subsurface experience. Desires responsible position. Box M-433, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, 35, ten years subsurface and staff experience, domestic and Latin America. Currently employed, desires to relocate. Box M-436, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST 31, M.S. 1960. Ten years diversified electronic experience while working my way through college. Interested in becoming associated with the oil industry. Free to travel or move anywhere. Complete resume sent upon request. P. O. Box 861, Richardson, Texas.

GEOPHYSICIST

Wide experience seismic interpretation and program supervision. Domestic assignment preferred. Box M-437, The Oil and Gas Journal, Tulsa, Oklahoma.

ADMINISTRATIVE Assistant, 38, B.B.A. 11 years diversified experience preparing unit, farmout and operating agreements, F.P.C. filings and general land work. Accounting, Revenue, Joint Account and Budget. Will relocate. 2962 Latham Dr., Dallas, Texas.

GEOLOGIST—11 years diversified experience in Ark-La-Tex area. Desires retainer or salary with independent or small active company. Box M-432, The Oil and Gas Journal, Tulsa, Oklahoma.

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PETROLEUM ENGINEER, 36, eleven years production experience. Will associate with operator of producing property as employee or partner. Box M-431, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGICAL Engineer, 10 years diversified experience in production, drilling, exploration, and landwork. Desires responsible position. Will relocate. Box M-438, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER, 34, Registered, 12 years experience in process design, operation and project engineering on gas processing plants with major and independent. Desires change to position with challenge and opportunity. Box M-439, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION FOREMAN: 35 married, 7 years experience, completions, work-overs, water flooding. Will relocate. Degree. Box M-440, The Oil and Gas Journal, Tulsa, Oklahoma.

SERVICES

HAVE YOU PLUGGED A PRODUCER?

Micro-Fluorologs prepared from your well cuttings will determine oil bearing stratas drilled through, and will indicate oil stratas at greater depth not yet drilled. Effective on old well samples or while being drilled. Logs: $100 per 1000 ft. Information:
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LEASES, DRILLING BLOCKS, good gas area, Eastern Oklahoma. Excellent geology. Can operate if required. Box M-426, The Oil and Gas Journal, Tulsa, Oklahoma.

INDEPENDENT production company leasing acreage in Ohio and West Virginia has 5,000 to 15,000 acre blocks. Excellent earning potential for small investors. Write or call: Ohio-West Virginia Production, Box 393, Marietta, Ohio. FR 3-6862.

CAMBRIDGE ARCH, Neb., Active operator seeks associate to develop a number of lease blocks. Some small acreage in Red Willow County. Others expand to several thousand acres, adjacent counties. Box M-411, The Oil and Gas Journal, Tulsa, Oklahoma.

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LEGAL

NOTICE IS HEREBY GIVEN that 29 tracts, comprising 8,408.72 acres of Tribal lands on the Wind River Reservation, Fremont County, Wyoming, are offered for competitive oil and gas leasing, under Oil and Gas Lease Sale No. 5, through sealed bids to the qualified bidder of the highest cash bonus offer per acre. Bids will be opened at 2:00 P.M., Mountain Standard Time, July 17, 1961, in the office of the Superintendent, Wind River Agency, Fort Washakie, Wyoming. Full details of the offering and how and where to submit bids may be obtained from the Superintendent, Wind River Agency, Fort Washakie, Wyoming. F. W. Pederson, Acting Superintendent.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Denver Colorado. Notice is hereby given that 840 acres of land in three parcels within the known structure of the Bell Rock Field, Moffat County, Colorado will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 2 p.m., M.S.T., July 26, 1961, when bids will be opened. Details of the lease offering, how and where to submit bids, and forms for bidding, may be obtained from Dale R. Andrus, Land Office Manager, P. O. Box 1018, Denver 1, Colorado.

LEGAL

SALE OF OIL AND GAS MINING LEASES, TRIBAL INDIAN LANDS, Department of the Interior, Bureau of Indian Affairs, Uintah and Ouray Agency, Fort Duchesne, Utah.

SEALED BIDS will be received until 2:00 P.M. Mountain Standard Time, July 6, 1961, and opened at that time in the office of the Uintah and Ouray Agency, Fort Duchesne, for leasing of 30,450.88 acres of Tribal Indian lands, located in Townships 4 and 5 South, Ranges 8, 9 and 10 West, Uinta meridian, Duchesne and Wasatch Counties, Utah, for oil and gas mining purposes. Details of the lease opening and how and where to file bids may be obtained by addressing an inquiry to the Superintendent, Uintah and Ouray Indian Agency, Fort Duchesne, Utah.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Land Office, Billings, Montana. Notice is hereby given that 3,355.54 acres of land within four known geological structures in the State of Montana and one known geological structure in the State of North Dakota are offered for oil and gas leasing by competitive bidding. The structure, county in which located and area of land offered are as follows: CEDAR CREEK FIELD, Fallon County, 1959.55 acres, Prairie County, 120 acres, Wibaux County, 35.99 acres; DRY CREEK FIELD, Carbon County, 680 acres; GAS RIDGE FIELD, Toole County, 240 acres; KEVIN-SUNBURST FIELD, 240 acres, all located in Montana. CROFF FIELD, McKenzie County, North Dakota, 80 acres. The above lands will be offered to the qualified bidder of the highest cash amount per acre at 10 a.m., M.S.T., July 18, 1961, when bids will be opened. Description of the lands offered, details of the lease offering, how and where to submit bids, may be obtained from the Land Office, Bureau of Land Management, 1245 North 29th Street, Billings, Montana. Thomas H. Floyd, Jr., Manager, Land Office.

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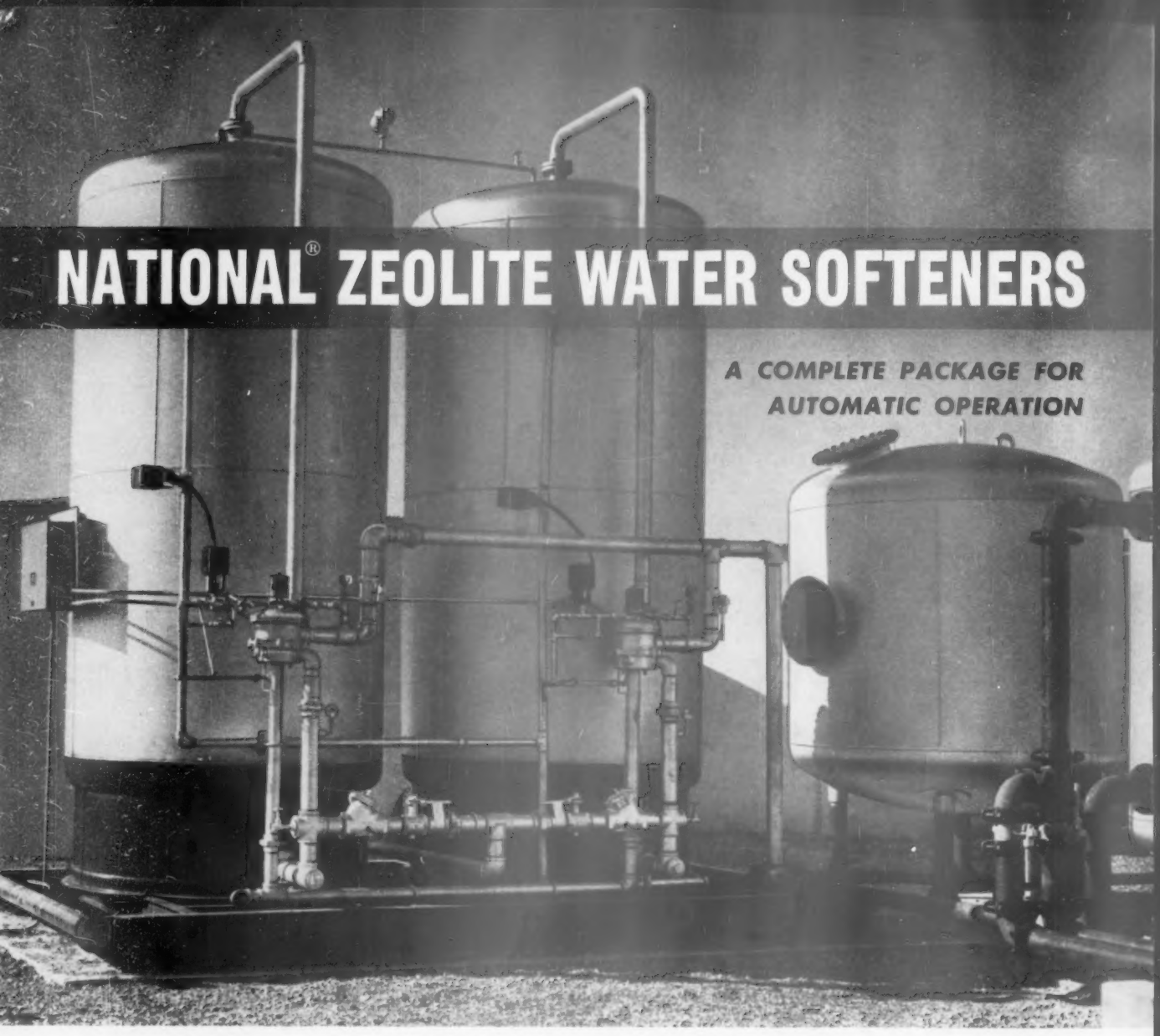

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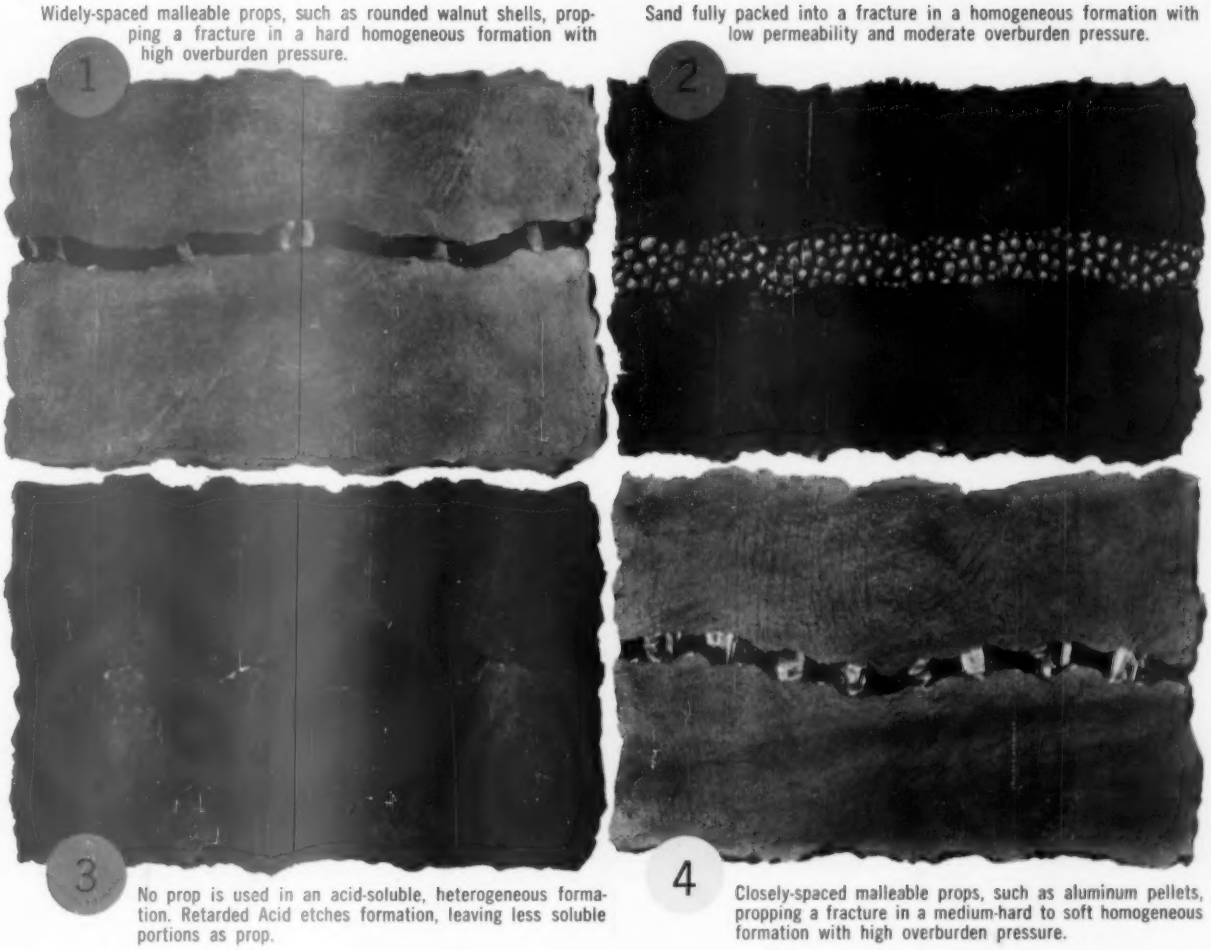
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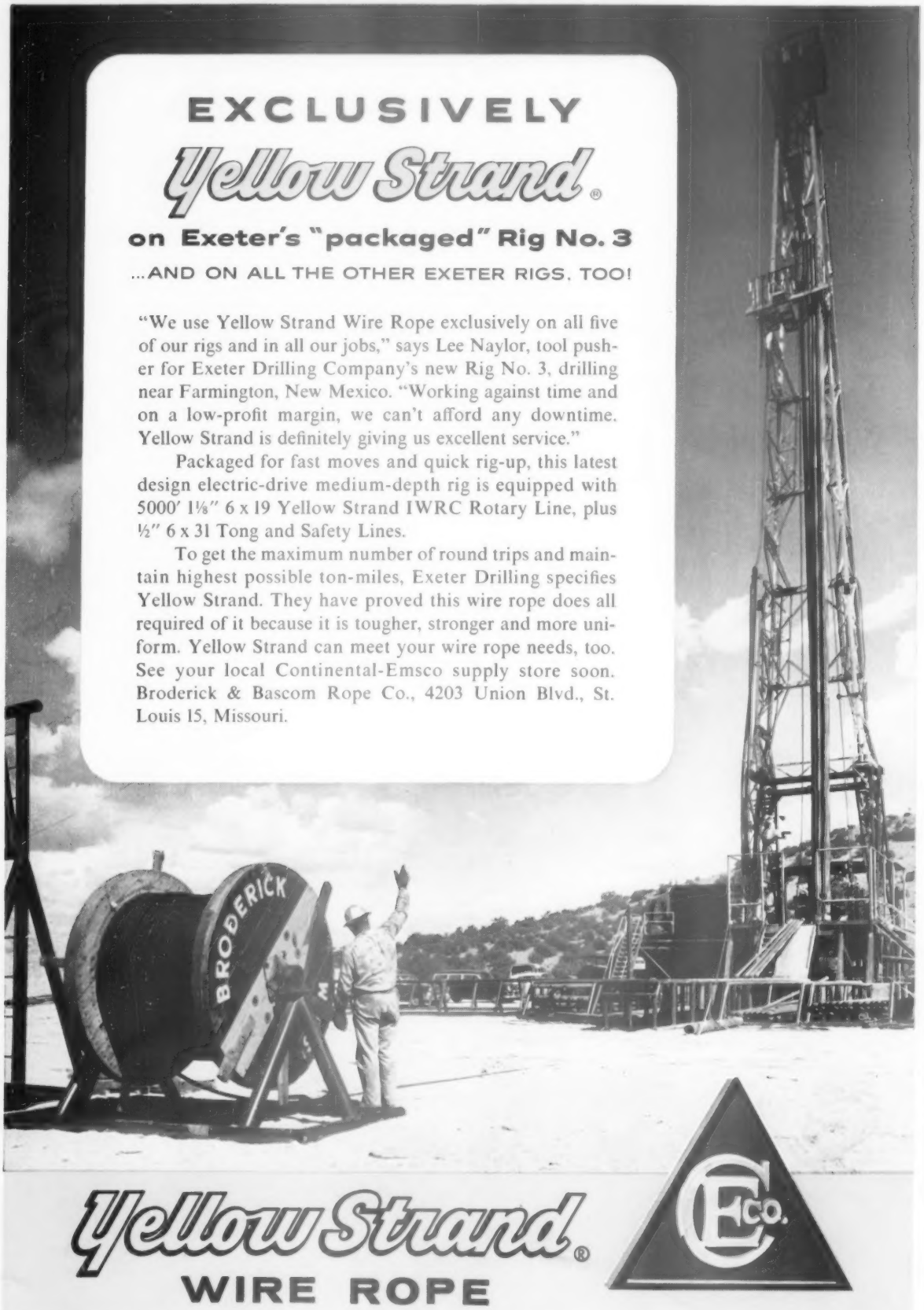

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